DPS-03

DISTRIBUTION PLANNING STANDARDS

DESIGN GUIDELINE OF OVERHEAD LINE LOW VOLTAGE NETWORK TO SUPPLY CUSTOMERS

Approved by:

Executive Director
Distribution Services Sector
Mohammed Bin Yousef Al-Taher

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1.0 INTRODUCTION

This document represents the new SEC Distribution Planning Standards (DPS) for Overhead Line Low Voltage Networks. This guideline should be applied and followed in place of Section No.3 named (Low Voltage Planning Criteria) in the existing SEC Distribution Planning Standards (DPS , Rev. 01 , Dated: March 2004).

2.0 SCOPE

This guideline describes the standards and criteria for electrical design and planning of overhead low voltage network and its layout to deliver the sufficient supply of electricity to new customers' loads within the defined standards limits of voltage and loading , and to maintain the reliability of power supply under all normal operating load and voltage conditions within the defined standards limits. It is intended to assist the planning engineers and field personnel to achieve standardization in design and planning and to ensure a satisfactory and economical level of service.

3.0 NEW FEATURES

The Major New Features in this guideline are :

1. LV Overhead Materials
2. Step by Step Design Procedures
3. Supply Method for LV Large Meters (300 , 400 , 500 , 600 , 800 Amp)
4. Supply Method for LV Customers with Load more than 800 Amp by Private/Dedicated Distribution Transformer
5. Special Case : LV Network for Random Area
6. Special Case : LV Network for Commercial Center
7. Advantageous Modules and Tables
8. Typical Layout for Overhead Low Voltage Network
9. Typical Distributed Loads per Outgoing of the Pole Mounted Transformer

4.0 DEFINITIONS

Customer :
It is any entity that purchases electrical power from a power utility. It is the owner of the building/facility supplied by SEC's power system. It is the owner of the supply request submitted to SEC to get electrical power.

Customer Interface Point :
It is the point at which a customer's load is connected to the SEC's power system. This shall normally be taken as the load side of the customer metering installation. The SEC shall normally be responsible for operating and maintaining all equipment up to the supply of this interface point. The customer shall be responsible for all equipment on the load side of this interface point.

Unit :
It is intended for the building's unit. Each unit should be used by one consumer. Each building can contain a single unit or multiple units. Each unit should be supplied by one KWH Meter according to SEC regulations.

Supply Request :
It is the request applied by the customer to get electric power supply from SEC's power system. It can contain a single building or multiple buildings and subsequently it can contain a single unit or multiple units and subsequently it can contain a single KWH Meter or multiple KWH Meters.

Connected Load (CL) :
It is the sum of all the nameplate ratings of all present and future electrical equipments & installations belongs to the customer's building/facility and could be used by the customer in future. It is to be estimated before applying any demand factor or diversity factor. It is expressed in Volt-Amperes (VA).

Demand Load (DL) :
It is the individual maximum demand load of a customer's building's unit usually occurring during the peak loading period (either estimated or measured). It must be calculated from the connected load of that customer's building's multiply by the approved demand factor of that customer's building's unit. It is expressed in Volt-Amperes (VA).

$$Demand\ Load\ =\ Connected\ Load\ \times\ Demand\ Factor$$

Demand Factor (DF):

It is the ratio of the Demand Load of a customer's building's unit to the Connected Load of that customer's building's unit.

$$Demand\ Factor\ =\ \frac{Demand\ Load}{Connected\ Load}$$

Total Demand Load (TDL):

It is the total (non-coincident) demand load of a customer's building with multiple units. It is the non-coincident summation of all individuals demand loads of all units belongs to that customer's building. It is expressed in Volt-Amperes (VA).

$$Total\ Demand\ Load\ =\ \Sigma(all\ individuals\ demand\ loads)$$

Coincident Demand Load (CDL):

It is the maximum (coincident) demand load of a customer's building with multiple units. It must be calculated from the Total Demand Load of that customer's building multiplying by the approved coincidence factor of that customer's building. It is expressed in Volt-Amperes (VA).

$$Coincident\ Demand\ Load\ =\ Total\ Demand\ Load\ \times\ Coincidence\ Factor$$

Coincidence Factor (CF) :

It is the ratio of the Coincident Demand Load of a customer's building with group of units (KWH Meters) to the Total Demand Load of that customer's building both taken at the same point of supply for the same time.

$$Coincidence\ Factor\ =\ \frac{Coincident\ Demand\ Load}{Total\ Demand\ Load}$$

Diversity Factor :

It is the inverse of the Coincidence Factor.

Contracted Load:

It is the capacity of power supply (in Volt-Amperes) equivalent to the circuit breaker rating (in Amperes) provided to the customer's KWH Meter. Supply connection fees and insurance charges are based on contracted load.

Low Voltage (LV) :
It is a class of nominal system voltages of 1000 Volts or less.

Nominal Voltage :
It is the voltage value, by which a system is designated and to which certain operating characteristics of the system are related.

Service Voltage :
It is the voltage value at the Customer's interface, declared by the Power Utility. This is generally expressed as a voltage range, in terms of a nominal voltage with plus and minus percentage variations.

Voltage Drop (VD) :
It is the difference in voltage between one point in a power system and another, typically between the supply substation bus and the extremities of a network. This is generally expressed as a percentage of the nominal voltage.

Firm Capacity :
Firm Capacity of any elements in LV Distribution Network is 80% of that element's rating.

5.0 STANDARD SERVICE VOLTAGES

The voltages listed in Table (1) shall be used as standard service voltages at the interface with power customers. The service voltage shall be maintained within the range defined by the indicated lowest and highest values, under steady state and normal system conditions and over the full loading range of the system. Where two voltages are listed e.g., 400/230 V the lower value refers to the phase to neutral voltage. All other values are phase-to-phase voltages

Table (1)

Nominal Voltage	Lowest Voltage	Highest Voltage
400/230 V	380/219 V	420/241 V
380/220 V	361/209 V	399/231 V
220/127 V	209/121 V	231/133 V
Percentage Limits	**- 5%**	**+ 5%**

6.0 LV OVERHEAD LINE MATERIALS

6.1 POLE MOUNTED TRANSFORMERS (PMT)

- The standard distribution transformer for overhead system is a pole mounted transformer (PMT) with LV Distribution Cabinet. These are commonly used in rural areas where loads are located scatteredly .Sizes and characteristics of the available transformer units are as follow in the Table (2) below:

Table (2)

Transformer		Voltage Ratio
Size	LV Feeder	
50 KVA	2	33/0.23, 33/0.4 KV or 13.8/0.23,13.8/0.4 KV
100 KVA	2	33/0.23, 33/0.4 KV or 13.8/0.23,13.8/0.4 KV
200 KVA	4	33/0.23, 33/0.4 KV or 13.8/0.23,13.8/0.4 KV
300 KVA	4	33/0.23, 33/0.4 KV or 13.8/0.23,13.8/0.4 KV

Detailed materials specifications for Pole Mounted Transformers are referred to SEC Distribution Materials Specification No. (51-SDMS-01, Rev.02) , No. (51-SDMS-02 , Rev.00) ,No. (51-SDMS-03, Rev.00) and No. (51-SDMS-04, Rev.00) with its latest updates.

- 50 KVA and 100 KVA size transformers shall be installed directly on pole and 200 & 300 KVA transformers shall be mounted on platform using H-pole.

Detailed Construction Specifications for Installation of Pole Mounted Transformers are referred to SEC Distribution Construction Standard No. (SDCS-01 , SECTION-13 , Rev.00) with its latest updates.

LV Terminations of Pole Mounted Transformer :

The following Aluminum Cables shall be used to connect the LV terminals of pole-mounted transformers to the LV Cabinet as follow in the Table (3) below:

Table (3)

Transformer (KVA)	Cables to be connected (Up to)
50 KVA	One 4c x 185 mm^2
100 KVA	One 4c x 185 mm^2
200 KVA	Two 4c x 185 mm^2
300 KVA (400/230 V)	Two 4c x 185 mm^2
300 KVA (231/133 V)	Two 4c x 300 mm^2

The sufficient No. & Size of Incomer Cables to be connected to pole-mounted transformers for different PMT's Ratings and for different Voltages (V) are shown in Table (4) below.

Table (4)

PMT Rating (KVA)	No. & Size of Incomer Cables for Different Voltages (V)		
	Standard Nominal Voltages		
	400	**380**	**220**
300	2×300 mm^2	2×300 mm^2	2×300 mm^2
200	2×185 mm^2	2×185 mm^2	2×300 mm^2
100	1×185 mm^2	1×185 mm^2	1×185 mm^2
50	1×70 mm^2	1×70 mm^2	1×70 mm^2

6.2 PRIMARY MV FUSE LINK RATINGS FOR PMT

The standard ratings of type K fuse links for different capacities of the pole mounted transformers which are fed from over head lines and controlled by drop out cutouts are enlisted below in Table (5).

Table (5)

Transformer capacity	Fuse link rating (K Type)	
(KVA)	**(13.8KV)**	**(33kv)**
50	8 A	3 A
100	15 A	6 A
200	20 A	10 A
300	30 A	15 A

Detailed materials specifications for Primary MV Fuse Link of PMT are referred to SEC Distribution Materials Specification No. (34-SDMS-02 , Rev.00) with its latest updates.

6.3 LV CABINET FOR POLE MOUNTED TRANSFORMER

The following PMT LV cabinets shall be used, as appropriate :

a) 800 Amps Cabinet with 4-MCCBs of 200 A rating.
It shall be mounted on H-Pole.

b) 400 Amps Cabinet with 2-MCCBs of 200 A rating.
It shall be mounted on single pole.

Detailed Construction Specifications for Installation of LV Cabinet for Pole Mounted Transformer are referred to SEC Distribution Construction Standard No. (SDCS-01 , SECTION-13 , Rev.00) with its latest updates.

The Bus bars of the Cabinet shall carry a rated nominal continuous current of 800 Amps for H-Pole cabinet and 400 Amps for single pole cabinet.

Main features of both types of PMT LV Cabinets are given in the below Table (6) :

Table (6)

Components	PMT Cabinets	
	Fixed on H-Pole	Fixed on Single Pole
PMT cabinet busbar rating (Amps.)	800	400
Number of in-coming Cables	2	1
Size of in-coming Cables (mm^2 , Aluminum)	185 or 300	70 or 185
Number of outgoing Cables	4	2
Rating of out-going MCCBs (Amps)	200	200
Size of out-going Cables (mm^2 , Quadruplex)	120	120
Transformer to be installed with PMT Cabinet	300 KVA (231/133 V) 300 KVA (400/231 V) 200 KVA (231/133 V) 200 KVA (400/231 V)	100 KVA (231/133 V) 100 KVA (400/231 V) 50 KVA (231/133 V) 50 KVA (400/231 V)

Outgoing terminals of PMT LV Cabinets shall be suitable for direct connection of 120mm² Al. Quadruplex overhead cables.

Detailed materials specifications for LV Cabinet of Pole Mounted Transformer are referred to SEC Distribution Materials Specification No. (31-SDMS-03 , Rev.01) with its latest updates.

6.4 LV OVERHEAD CONDUCTORS

The LV overhead line conductor shall be a quadruplex cable. The three insulated phase conductors and the bare neutral shall be twisted together to form what is called a quadruplex conductor consisting of three XLPE insulated aluminum conductors laid up around one bare ACSR/AW. The neutral shall act as a messenger for L.V spans up to 50m for main feeder and 30m for service drop.

Two standard sizes of conductors shall be used in the overhead low voltage distribution network as following :

1) Quadruplex conductor 3x (1x120 mm^2 XLPE insulated Aluminum Conductor) + 1x120 mm^2 ACSR/AW , for main line/feeder.
2) Quadruplex conductor 3x(1x50 mm^2 XLPE insulated Aluminum Conductor) + 1x50 mm^2 ACSR/AW , for service drops as connection to the customer.

Service drop cable is the portion of the system which makes the final connection from the low voltage network to the consumer's premises.

Detailed materials specifications for LV Overhead Line Conductor are referred to SEC Distribution Materials Specification No. (11-SDMS-02 , Rev.00) with its latest updates.

The conductor current ratings in (A) and equivalent capacities in (KVA) at different low voltages are given in Table (7) below :

Table (7)

LV Conductor Size	Rating (Amps)	Rating (KVA) for Different Voltages (V)		
		Standard Nominal Voltages		
		400	380	220
4 X 120 mm^2 AL, Quadruplex	200	139	132	76
4 X 50 mm^2 AL, Quadruplex	110	76	72	42

Note: *These ratings are based on calculations derived from ANSI/IEEE Std. 738-1986 : IEEE Standard for Calculation of Bare Overhead Conductor Temperature and Ampacity Under Steady-State Conditions. They are based on the standard rating conditions indicated in Table (9) and the conductor characteristics indicated in Table (8). Correction factors for deviations from these conditions are indicated in Table (26) & Table (27) & Table (28) & Table (29)*.

The Conductor Characteristics (AC resistance and reactance) values are given in Table (8) below :

Table (8)

LV Conductor Size	R_{AC} 20 °C Ohms / km	X_1 (60HZ) Ohms / km
4 X 120 mm² AL, Quadruplex	0.31037	0.099
4 X 50 mm² AL, Quadruplex	0.78353	0.106

Note: *Impedance values are ohms per km per phase for each conductor type. Multiply by square root of 3 to derive equivalent line values. Indicated values are positive / negative sequence impedance values. The AC resistance values take account of skin. The reactance values only include line inductance effects. Capacitance effects are ignored for these voltage levels. The inductance values are based on a geometric mean conductor spacing as follows: 33 KV 1.5 m , 13.8 KV 1.25 m , L.V. 0.6 m. The geometric mean conductor spacing is the cube root of the product of the three phases inter – conductor spacing.*

Standard Overhead Lines Conductors Rating Conditions

Overhead Lines Conductors ratings given in Table (7) are based on the following standard conditions mentioned in Table (9) below :

Table (9)

Ambient Temperature	50 °C.
Minimum Wind Velocity	0.6 m/sec.
Altitude (above sea level)	1000 m
Maximum Continuous Conductor Operating Temperature	80 °C
Emissivity (for Cu. And Al.)	0.5
Absorptive (of solar heat)	0.5

6.5 LV UNDERGROUND CABLES

1) 120 sq.mm quadruplex shall be used as standard for main LV feeder wherever in the Overhead Low Voltage network.

2) 50 sq.mm quadruplex or 120 sq.mm quadruplex shall be used for service drops as connection to customers wherever in the Overhead Low Voltage network. Only wherever connection cannot be served by 50 sq.mm quadruplex or 120 sq.mm quadruplex , 4 x 70 sq.mm XLPE or 4 x 185 sq.mm XLPE underground cable can be used as service connection cable.

6.6 LV SERVICE CONNECTIONS CIRCUIT BREAKERS

Molded Case Circuit Breakers (MCCB) for indoor or outdoor installation in an enclosure , intended to be used for Service Connections in the Low Voltage System. The Standard Ratings for the Circuit Breakers are (20 , 30 , 40 , 50, 70 , 100 , 125 , 150 , 200 , 250 , 300 , 400 , 500 , 600 , 800)
The incoming terminals shall be suitable for both copper and aluminum conductors of sizes given for the following different ratings as shown in Table (10).

Table (10)

MCCB Rating (Amps)	Max size of conductors suitable for the incoming terminals
20 ,30 , 40 ,50 , 70 ,100 ,125, 150	Copper conductor up to 35mm²
200 , 250	Copper conductor up to 120mm²
300 , 400 , 500 , 600 , 800	copper/aluminum conductor up to 300mm²

Detailed materials specifications for LV Service Connections Circuit Breakers are referred to SEC Distribution Materials Specification No. (37-SDMS-01, Rev.03) with its latest updates.

6.7 KWH METERS

Electro-mechanical and Electronic Kilo-Watt-Hour (KWH) meters, intended to be used for revenue metering in the system.

The KWH meters used by SEC are classified as given below in Table (11) :

Table (11)

Meter Type	Meter CB Rating (A)
Whole Current Meter	20 , 30 , 40 , 50 , 70 , 100 , 125, 150
CT Operated Meter	200 A ,250 , 300 A , 400 A , 500 A , 600 A , 800

Detailed materials specifications for Kilo-Watt-Hour Meters are referred to SEC Distribution Materials Specification No. (40-SDMS-01 Rev.02) , No. (40-SDMS-02A Rev .07) and No.(40-SDMS-02B Rev .06) with its latest updates.

6.8 METERS BOXES

Fiberglass reinforced polyester boxes to be used for Kilo Watt Hour (KWH) meters in the distribution system.

The meter boxes used by SEC are classified as given below in Table (12) :

Table (12)

Meter Box Type	No. & Type of Meters	Meter CB Rating
Single meter box	one whole current meter	rated up to 150 A
Double meter box	two whole current meters	each rated up to 150 A
Quadruple meter box	four whole current meters	each rated up to 150 A
200/250 A CT meter box	one CT meter	rated 200/250 A
300/400 A CT meter box	one CT meter	rated 300/400 A
500/600 A CT meter box	one CT meter	rated 500/600 A
800 A Remote meter box	one CT meter	rated 800 A

The incoming terminals shall be suitable for sizes of LV Cables given for the following different Meter Box types as shown in Table (13) below.

Table (13)

Meter Box Type	Max size of LV Cables suitable for the incoming terminals	Box Rating
Single meter box	two cables of sizes up to 4x70 mm² AL	200 Amps
Double meter box	two cables of sizes up to 4x185 mm² AL	300 Amps
Quadruple meter box	two cables of sizes up to 4x300 mm² AL	400 Amps
200/250 A CT meter box	two cables of sizes up to one 4 x 300 mm² + one 4 x 185 mm²	400 Amps
300/400 A CT meter box	two back to back cables of sizes up to one 4 x 300 mm² + one 4 x 185 mm²	400 Amps
500/600 A CT meter box	two back to back cables of sizes up to 4 x 300 mm²	600 Amps
800 A Remote meter box	two cables of sizes up to 4 x 300 mm²	800 Amps

Detailed materials specifications for Meter Boxes are referred to SEC Distribution Materials Specification No. (42-SDMS-01, Rev.04) , No. (42-SDMS-02, Rev.00) and No. (42-SDMS-03, Rev.00) with its latest updates.

7.0 OVERHEAD LOW VOLTAGE NETWORK CONFIGURATION

There are three standard configurations for customer low voltage Overhead connections depends on customers demand loads as following :

(a) OH Main Feeder with Service Drop 50 mm^2 Quadruplex Conductor

This type of Configuration is shown in Figure (1) , For this condition, Quadruplex Conductor 120 mm^2 shall be used as main OH LV feeder from PMT LV Cabinet to Customer Location , and Quadruplex Conductor 50 mm^2 shall be used as service drop connection from that location to the customer meter/meters box. **(Common Configuration)**.

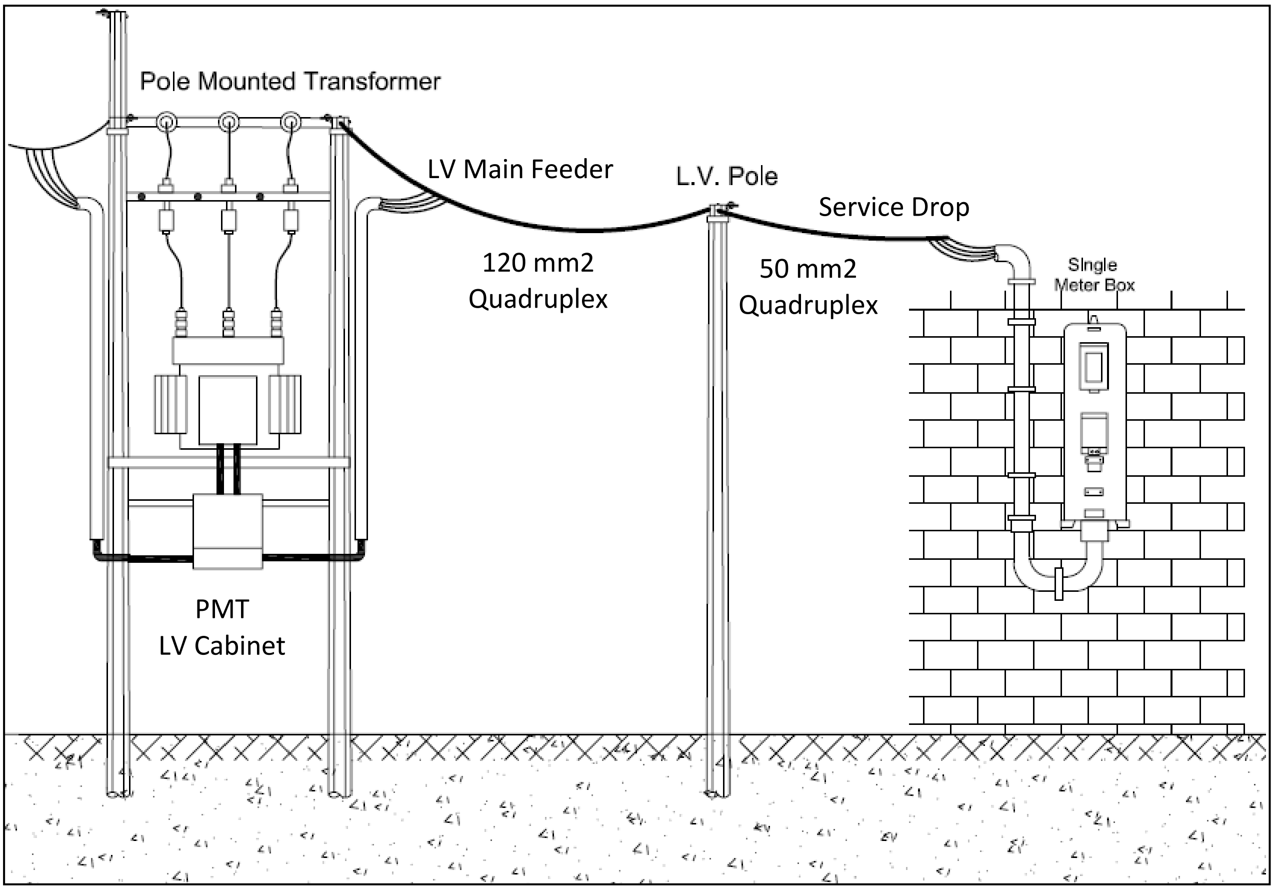


Figure (1)

(b) OH Main Feeder with Service Drop 120 mm^2 Quadruplex Conductor

This type of Configuration can be used only when Quadruplex Conductor 50 mm^2 is not sufficient to supply the customer demand load. It is shown in Figure (2) , For this condition, Quadruplex Conductor 120 mm^2 shall be used as main OH LV feeder from PMT LV Cabinet to Customer Location , and Quadruplex Conductor 120 mm^2 can also be used as service drop connection from that location to the customer meter/meters box. **(Heavy Load Lots only)**.

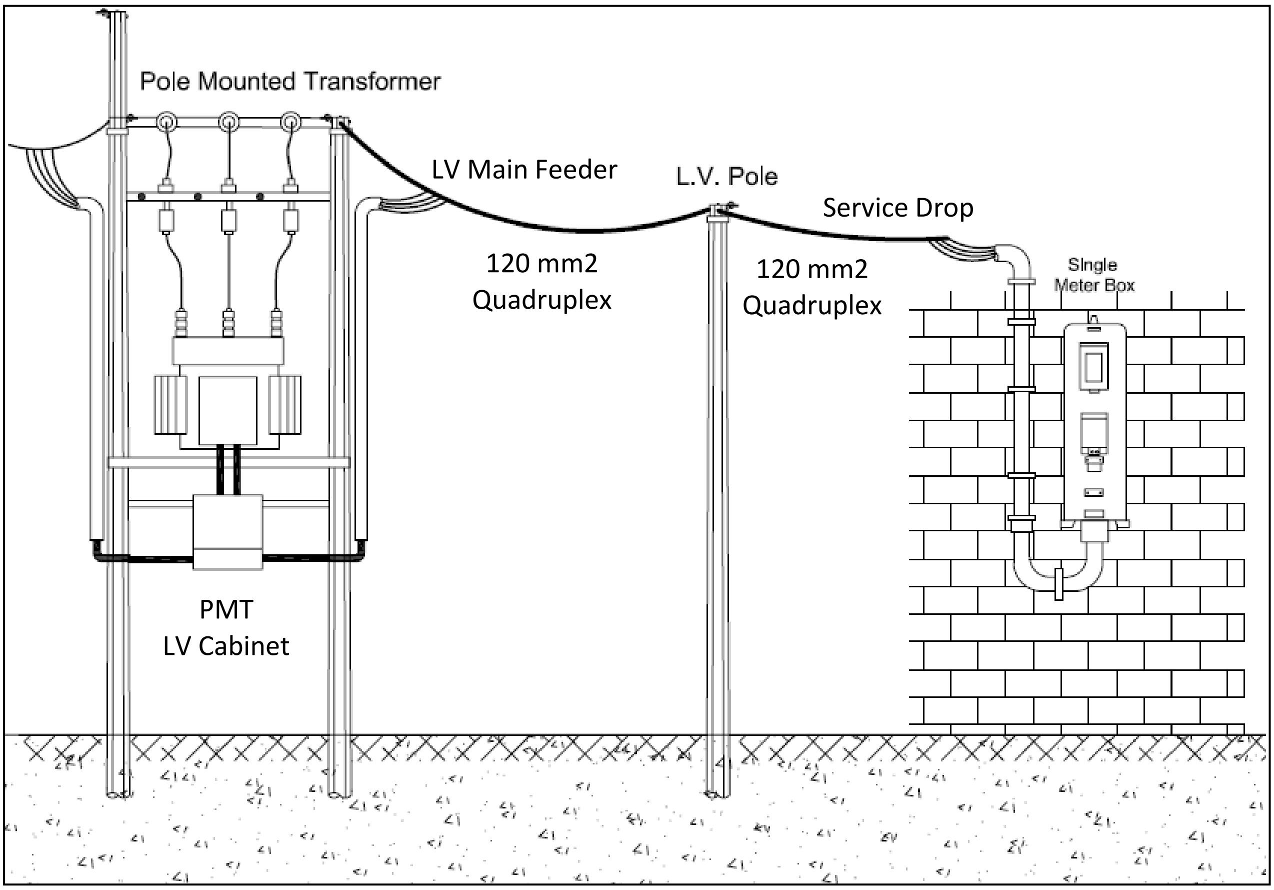


Figure (2)

(c) OH Main Feeder with Service Connection UG Cable

This type of Configuration can be used only when there is a physical hindrance to use Quadruplex Conductor as service drop connection to the customer. It is shown in Figure (3) , For this condition, Quadruplex Conductor 120 mm^2 shall be used as main OH LV feeder from PMT LV Cabinet to the nearest pole to Customer Location , and UG Cable 70 mm2 or 185 mm2 (depending on customer load) can be used as service connection from the nearest pole to the customer meter/meters box. **(Exceptional Configuration)**.

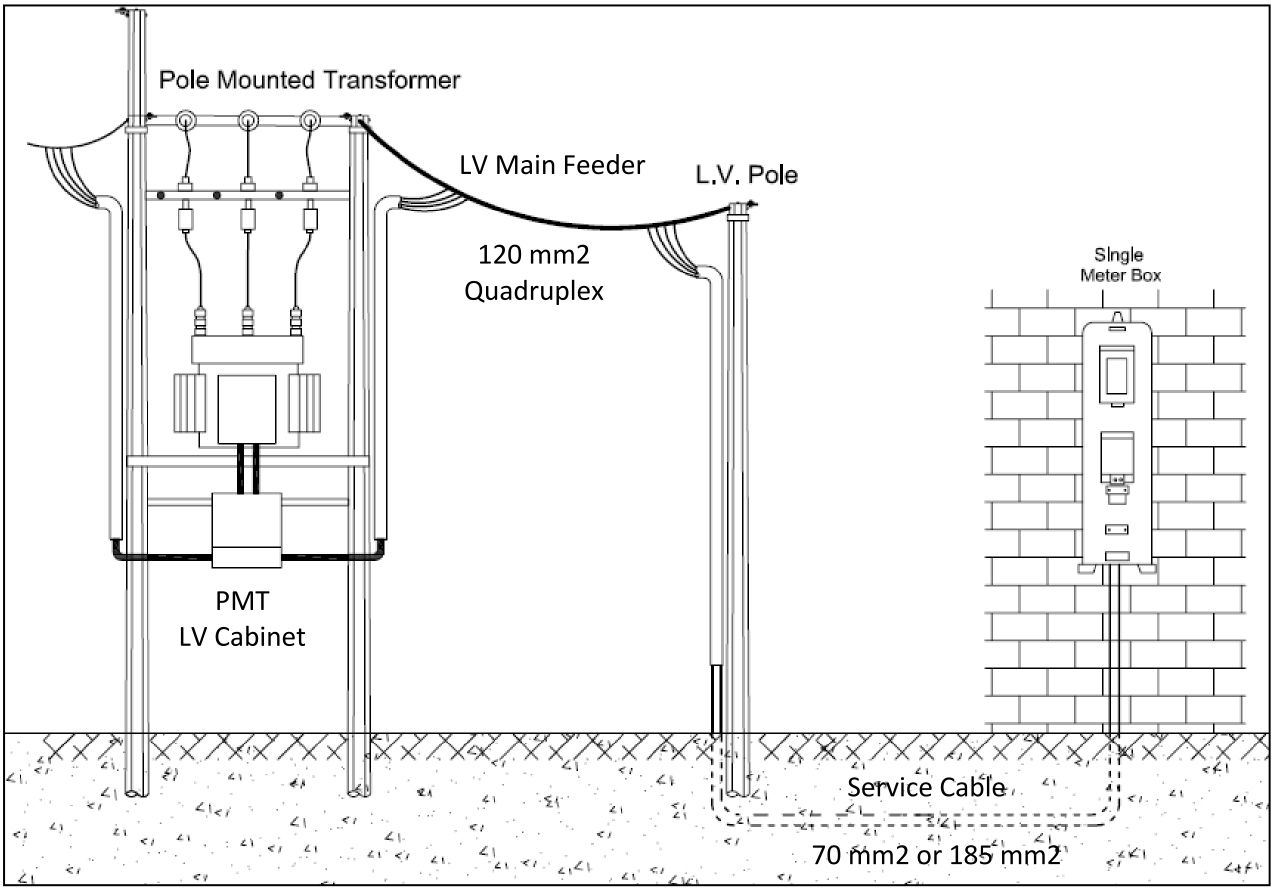


Figure (3)

8.0 PRINCIPLES OF DESIGN

The Low voltage networks (also called secondary network) are connected at one end and have no facility of back-feeding.

The following objectives should be achieved in the design of low voltage networks taking into account all prevailing safety and reliability standards :

- Satisfaction of Customer Coincident Demand Load.

- Equipment ratings are not exceeded.
  - ✓ The LV OH Conductor(s) shall not be loaded more than 80% of its rated capacity.
  - ✓ The PMT's Low Voltage Cabinet shall not be loaded more than 80% of its rated capacity.
  - ✓ The loading of the Pole Mounted Transformers (PMT) shall not exceed 80% of full load rated capacity (KVA).

- Voltage Drops are within allowable limits:
  - ✓ Service Voltage at customer supply interface point must be within ± 5% of nominal voltage.
  - ✓ Voltage Drop at customer supply interface point shall not exceed 5% of nominal voltage.

- The design is the most economical (Low Cost) for the projected load and layout.

8.1 CUSTOMER'S COINCIDENT DEMAND LOAD

Estimation of Customer's Coincident Demand Load should be referred to SEC Distribution Planning Standards No. (DPS-01, Rev.02) named (Estimation of Customer Load Guideline) with its latest updates.

8.2 COINCIDENT DEMAND LOAD ON LV NETOWRK ELEMENTS

The following Formula should be used to calculate the Coincident Demand Load (CDL) on any LV Network Element for the group of all KWH Meters supplied by that LV Network Element as below.

$$CDL_{\substack{on\ Network \\ Element}} = \left(\sum_{i=1}^{N} CBR_i \times DF_i \right) \times CF(N)$$

Where :

N = Number of all KWH Meters supplied by that LV Network Element (PMT , LV Main Feeder , Service Drop Connection).

CBR_i = Circuit Breaker Rating in (Amp) for the Individual KWH Meter no. (i).

DF_i = Demand Factor for the Individual KWH Meter no. (i) which should be determined according to the utilization nature of the concerned Individual unit no. (i) in customer's building and referring to SEC Distribution Planning Standards No.(DPS-01, Rev. 02) titled (Estimation of Customer Load Guideline) with its latest updates.

$CF(N)$ = Coincident Factor for the group of all KWH Meters supplied by that LV Network Element (PMT , LV Main Feeder , Service Drop) which should be determined according to Number of these KWH Meters (N) and referring to SEC Distribution Planning Standards No.(DPS-01, Rev. 02) titled (Estimation of Customer Load Guideline) with its latest updates. It can be calculated by the following equation :

$$CF(N) = \frac{\left(0.67 + \frac{0.33}{\sqrt{N}}\right)}{1.25}$$

$$For\ N = 1 \Rightarrow CF(N) = 1$$

8.3 EQUIPMENT CHARACTERISTICS (FULL RATING & FIRM CAPACITY)

The loading percentage on all LV Equipments shall not exceed its Firm Capacity (80% of its ratings).

a) **The LV OH Conductors** shall not be loaded more than its Firm Capacity (80% of its rated capacity) given in Table (15) below.

Table (14)

LV Conductor Size	Rating (Amps)	Rating (KVA) for Different Voltages (V)		
		Standard Nominal Voltages		
		400	**380**	**220**
4 X 120 mm² AL, Quadruplex	200	139	132	76
4 X 50 mm² AL, Quadruplex	110	76	72	42

Table (15)

LV Conductor Size	Firm Capacity (Amps)	Firm Capacity (KVA) for Different Voltages (V)		
		Standard Nominal Voltages		
		400	**380**	**220**
4 X 120 mm² AL, Quadruplex	160	111	105	61
4 X 50 mm² AL, Quadruplex	88	61	58	34

Firm Capacity = 80% × Rating

b) **The PMT Low Voltage Cabinets** shall not be loaded more than its Firm Capacity (80% of its rated capacity) given below in Table (17).

Table (16)

PMT Low Voltage Cabinet	Rating (Amps)	Rating (KVA) for Different Voltages (V)		
		Standard Nominal Voltages		
		400	**380**	**220**
H-Pole Cabinet	800	554	527	305
Single Pole Cabinet	400	277	263	152

Table (17)

PMT Low Voltage Cabinet	Firm Capacity (Amps)	Firm Capacity (KVA) for Different Voltages (V)		
		Standard Nominal Voltages		
		400	**380**	**220**
H-Pole Cabinet	640	443	421	244
Single Pole Cabinet	320	222	211	122

Firm Capacity = 80% × Rating

c) **The Pole Mounted Transformers** shall not be loaded more than its Firm Capacity (80% of its rated capacity) given in Table (18) below.

Table (18)

Pole Mounted Transformer	Rating (KVA)	Firm Capacity (KVA)
50 KVA	50	40
100 KVA	100	80
200 KVA	200	160
300 KVA	300	240

Firm Capacity = 80% × Rating

8.4 VOLTAGE DROP CALCULATION

For a particular supply voltage the voltage drop from the supply point to the customer interface depends on various factors such as customer demand, length and size of conductor, power factor. Formula for voltage drop is provided below :

$$VD\% = \frac{100 \times KVA \times (R \times cos\ \varphi + X \times sin\ \varphi) \times L}{V^2}$$

Where:
$VD\%$ = Voltage drop percentage on the conductor in (%)
KVA = Three phase power in (KVA)
= Coincident Demand Load (CDL) on the conductor.
R = Resistance of conductor in ohm per kilometer in (Ω/km)
X = Inductive reactance of conductor in ohm per kilometer in (Ω/km)
φ = Power factor angle of the supply
V = Three phase supply nominal voltage in (volts)
L = Length of the conductor in (meters)

The formula has reduced to a simple constant ***K*** equivalent to the product of KVA and conductor's length in meter at power factor of 0.85 lagging. For various values of KVA-meter the voltage drop can be calculated by dividing it with this constant ***K***.

$$K = \frac{V^2}{100 \times (R \times cos\varphi + X \times sin\varphi)}$$

The value of the ***K*** constant changes with the supply voltage, power factor and size and type of conductor, due to the change of resistance and inductance. The calculations of ***K*** values are shown in Table (19) below.

Table (19)

Conductor Size	V	R	X	cos ϕ	sin ϕ	K
mm2	Volts	Ω/km	Ω/km			V^2.km/Ω
120	400	0.31037	0.099	0.85	0.527	5064
120	380	0.31037	0.099	0.85	0.527	4570
120	220	0.31037	0.099	0.85	0.527	1532
50	400	0.78353	0.106	0.85	0.527	2217
50	380	0.78353	0.106	0.85	0.527	2000
50	220	0.78353	0.106	0.85	0.527	671

The values of ***K*** constant to be used for various standard LV conductors are provided hereunder in table (20):

Table (20)

LV Conductor Size	Constant K		
	Standard Nominal Voltages		
	400 V	380 V	220 V
4 X 120 mm² AL, Quadruplex	5064	4570	1532
4 X 50 mm² AL, Quadruplex	2217	2000	671

The simplified formula for Voltage Drop calculation is :

$$VD\% = \frac{KVA \times L}{K}$$

Where:

$VD\%$ = Voltage drop percentage on the conductor in (%)

KVA = Three phase power in (KVA)

= Coincident Demand Load (CDL) on the conductor

L = Length of the conductor in (meters)

K = The constant in (V^2.km/Ω) according to Table (20) above

<u>Note:</u> Above Voltage Drop calculations formula are based on balanced 3-Phase system.

Example :

Max Lengths (m) can be achieved within (5%) Voltage Drop with Loading up to Firm Capacity (KVA) for Different Nominal Voltages (V) for Different Sizes of LV Conductors are calculated using the above formula, as shown in Table (21) below.

Table (21)

LV Conductor Size	Max Length (m) within (5%) Voltage Drop with Loading up to Firm Capacity (KVA) for Different Voltages (V)		
	400 V	380 V	220 V
4 X 120 mm² AL, Quadruplex	228	217	126
4 X 50 mm² AL, Quadruplex	182	173	100

Voltage Drop Allocation :

The Utility voltage drop allocations listed in Table (22) shall be used as guideline voltage drops over the power system components supplying a low voltage customer to minimize lengths of Service Conductors as possible.

Table (22)

LV Network Component	Voltage Drop %
LV Main Feeder	3.5
Service Drop Connection	1.5
Total Voltage Drop	**5.0**

Example :

Max Lengths (m) can be achieved within (5%) Voltage Drop with Loading up to Firm Capacity (KVA) on Main LV Feeder (120 mm^2) & with (30 A) LV Meter (0.6 DF) on Service Drop (50 mm^2) for Different Nominal Voltages (V) are calculated by using the Voltage Drop calculations formula and by applying the voltage drop allocations values listed in Table (22), as shown in Table (23) below.

Table (23)

Voltage Drop (%) =		3.5	1.5	5
LV Conductor Size		120 mm²	50 mm²	Total Length (m)
Max Length (m) within (5%) Voltage Drop with Loading up to Firm Capacity (KVA) on LV Main Feeder (120 mm^2) & with (30 A) Meter (0.6 DF) on Service Drop (50 mm^2) for Different Voltages (V)	400 V	160	267	426
	380 V	152	253	405
	220 V	88	147	235

Factors Affecting the Voltage Drop :

Following are the other factors affecting the Voltage Drop :

a) The representation of the 3 phase, phase-phase and phase-neutral loads will be a single phase system derived from the assumption that the load is balanced. It is known that the above is an over simplification and that site measurements show that one or two phases are more heavily loaded. This real situation shows that a correction factor is required. This is known as the unequal loading in the phase.

b) In the SEC system, loads are mainly phase-phase with a smaller superimposed phase-neutral load distributed over the 3 phases. The phase-neutral loads give rise to the unequal loading in the phase.

c) Neutral current produces a voltage drop which has to be added to the phase conductor voltage drop. The value of this neutral current which will flow is different throughout the length of the conductor due to the vectorial addition. A correction factor is required to allow for neutral current voltage drop.

d) The reactive impedance of the conductor produces a voltage drop which is dependent on the power factor of the loads. Power factor of 0.85 has been built into the calculation above.

e) The resistance value of aluminum varies with temperature. In a distributor supplying a number of customers the current is not a constant value throughout the conductor and the temperature of the conductor core will change along the length of the conductor.

f) The rating of the conductors used is very dependent upon the cyclic nature of the load. For the period when high loads are expected on the conductor a daily load factor of less than one has been observed. Load factors lower than 0.84 allow considerable increase in the amps/phase which the conductor can safely carry. However there is a change over point where the voltage drop along the distributor is reached before the thermal limit is reached and there is no benefit from an increase in the permitted amps which a conductor can carry beyond those quoted

g) Loads are assumed to be either applied as point or end loads or can be assumed to be evenly distributed and therefore acting as end load applied at the mid-point of the distributor length. Loads per villa are calculated in accordance with the tabulation based on Municipality Building Permit. The tabulation has been correlated to the Ministry of Electricity Rules.

h) The currents flowing in each branch of the distributor required to be diversified in accordance with the Diversity Factors for Systems which have been derived from system measurements and observations.

8.5 GENERAL PRINCIPLES OF DESIGN

1. Design of any LV network element (PMT , LV Main Feeder , Service Drop Connection) should be based on the Coincident Demand Load (CDL) of all customers KWH Meters supplied from this element LV network element.
2. To maintain the Loading percentage on any LV network element (PMT , LV Main Feeder , Service Drop Connection) within the Firm Capacity (80 % of Rating) of that LV network element.
3. To maintain the Total Voltage Drop percentage on the whole LV network (LV Main Feeder + Service Drop Connection) from the PMT to the customer's location within the Voltage Drop limits (5 % of Nominal Voltage).
4. The LV network design should be the most economical (Lowest Cost) as possible to supply the projected customer's load.
5. The suitable size of the conductor to supply the customer should be selected according to the Coincident Demand Load (CDL) of that customer and should be suitable to satisfy that customer's CDL is not greater than the Firm Capacity (80 % of Rating) of that conductor.
6. The suitable connection configuration type to supply the customer should be selected according to the Coincident Demand Load (CDL) of that customer.
7. CDL on the PMT should be not greater than PMT's Firm Capacity (i.e. not exceeding 80 % of PMT's rating).

$$CDL\ (KVA)_{on\ PMT} = CDL\ for\ all\ N\ Meters\ supplied\ from\ PMT$$

$$Loading\ \%_{on\ PMT} = \frac{CDL\ (KVA)_{on\ PMT}}{Rating_{PMT}} \times 100$$

8. CDL on the LV Main Feeder should be not greater than LV Main Feeder's Firm Capacity (i.e. not exceeding 80 % of LV Main Feeder's rating).

$$CDL_{on\ Main\ Feeder} = CDL\ for\ all\ N\ Meters\ supplied\ from\ Main\ Feeder$$

$$Loading\ \%_{on\ Main\ Feeder} = \frac{CDL_{on\ Main\ Feeder}}{Rating_{Main\ Feeder}} \times 100$$

9. CDL on the Service Drop should be not greater than Service Drop's Firm Capacity (i.e. not exceeding 80 % of Service Drop's rating).

$$CDL_{on\ Service\ Drop} = CDL\ for\ all\ N\ Meters\ supplied\ from\ Service\ Drop$$

$$Loading\ \%_{on\ Service\ Drop} = \frac{CDL_{on\ Service\ Drop}}{Rating_{Service\ Drop}} \times 100$$

10. CDL on the Direct Feeder should be not greater than Direct Feeder's Firm Capacity (i.e. not exceeding 80 % of Direct Feeder's rating).

$$CDL_{\text{on Direct Feeder}} = CDL \text{ for all } N \text{ Meters supplied from Direct Feeder}$$

$$Loading\ \%_{\text{on Direct Feeder}} = \frac{CDL_{\text{on Direct Feeder}}}{Rating_{\text{Direct Feeder}}} \times 100$$

11. Total VD% from PMT to customer's location should be not greater than voltage drop limit (i.e. not exceeding 5 %).

$$VD\ \%_{\text{Service Drop}} = \frac{CDL\ (KVA)_{\text{on Service Drop}} \times L_{\text{Service Drop}}}{K_{\text{Service Drop}}}$$

$$VD\ \%_{\text{Main Feeder}} = \frac{CDL\ (KVA)_{\text{on Main Feeder}} \times L_{\text{Main Feeder}}}{K_{\text{Main Feeder}}}$$

$$VD\ \%_{\text{Direct Feeder}} = \frac{CDL\ (KVA)_{\text{on Direct Feeder}} \times L_{\text{Direct Feeder}}}{K_{\text{Direct Feeder}}}$$

$$VD\ \%_{\substack{\text{Total} \\ \text{from PMT to Customer}}} = VD\ \%_{\text{Main Feeder}} + VD\ \%_{\text{Service Drop}}$$

$$VD\ \%_{\substack{\text{Total} \\ \text{from PMT to Customer}}} = VD\ \%_{\text{Direct Feeder}}$$

12. Always try first to supply customer's CDL from any existing nearby LV Main Feeders (one by one) with priority for the nearest as possible based on the criteria (Loading % , Voltage Drop %) before planning to install new LV Main Feeder.
13. Always try first to supply customer's CDL from any existing nearby PMT's (one by one) with priority for the nearest as possible based on the criteria (Loading % , Voltage Drop %) before planning to install new PMT.
14. To supply customer's CDL from any existing LV Main Feeder, first check for capability of supply from that LV Main Feeder.
15. To supply customer's CDL from any existing PMT , first check for availability of any vacant outgoing in that PMT.
16. Install the new PMT in the center of loads area (including : concerned new customer , existing others nearby supply requests , nearby under constructions buildings , empty lots) as possible.
17. Select the shortest geographic route for the LV Main Feeder (120 mm^2 cable) from PMT to the customer's location (as possible).
18. Select the shortest geographic route for the service drop from the LV Main Feeder to customer's location (as possible).
19. Select the shortest geographic route for the Direct Feeder from PMT to the customer's location (as possible).

20. Avoid crossing the streets when you design the route of any LV conductor as possible as you can.
21. It is not allowed to cross any street with width more than 36 meters for any LV conductor rout.
22. CB rating of the outgoing from PMT LV Cabinet should be not lesser than the largest CB rating of all KWH Meters supplied from this outgoing CB. Same is valid for any two CBs outgoings supply customers.
23. CB rating of the outgoing from PMT LV Cabinet should be not lesser than the Coincident Demand Load (CDL) of all customers KWH Meters supplied from this outgoing CB. Same is valid for any two CBs outgoings supply customers.
24. Size (KVA rating) of the new PMT should be selected based on the need of the neighbor area (including : concerned new customer , existing others nearby supply requests , nearby under constructions buildings , existing empty lots) and it should be as minimum as sufficient to meet their total Coincident Demand Load (CDL).
25. If multi PMTs are required to supply a customer , select the no. of the required PMTs and their ratings from the available SEC standard (50, 100, 200, 300 KVA) where the summation of PMTs ratings should provide minimum sufficient total capacity to meet the calculated Coincident Demand Load (CDL) of the customer with minimum no. of PMTs.
26. For supplying new customers , It is preferred to avoid using the PMT with 300 KVA rating as possible and it is preferred to use the PMT with (100 KVA or 200 KVA) rating instead of that. This is to maintain a possibility for reinforcement of these PMTs (100 KVA & 200 KVA) by replacing them with 300 KVA PMTs without the need to install a new PMT.
27. The PMT with 50 KVA rating can be used in light load density area and also for remote dedicated customers with light loads.
28. No. of Meter Boxes and their sizes required to handle the KWH Meters required to supply a customer should be as minimum as sufficient with minimum no. of Meter Boxes. i.e. always use larger size of Meter Box to handle more possible KWH Meters in one box instead to use multi smaller size of Meter Boxes for same no. of KWH Meters.
29. To supply a new customer's CDL from an existing LV Main Feeder , evaluation for the criteria (Loading % , Voltage Drop %) should be based on the Coincident Demand Load (CDL) of all customers KWH Meters (concerned new customer + existing customers) supplied from this LV Main Feeder. Only in case that the measured Maximum Demand (MD) on that LV Main Feeder is greater than CDL of existing customers , so the CDL of the concerned new customer should be

corrected by the scaling of MD on LV Main Feeder as shown in the following equation :

$$CDL_{\substack{New\ Customer \\ Corrected}} = CDL_{New\ Customer} \times \frac{MD_{on\ Main\ Feeder\ for\ Existing\ Customers}}{CDL_{on\ Main\ Feeder\ for\ Existing\ Customers}}$$

Then evaluating for the criteria (Loading % , Voltage Drop %) should be based on summation of MD on LV Main Feeder and the corrected CDL of concerned new customer.

30. To supply a new customer's CDL from an existing PMT , evaluation for the criteria (Loading % , Voltage Drop %) should be based on the Coincident Demand Load (CDL) of all customers KWH Meters (concerned new customer + existing customers) supplied from this PMT. <u>Only in case that the measured Maximum Demand (MD) on that PMT is greater than CDL of existing customers</u> , so the CDL of the concerned new customer should be corrected by the scaling of MD on PMT as shown in the following equation :

$$CDL_{\substack{New\ Customer \\ Corrected}} = CDL_{New\ Customer} \times \frac{MD_{on\ PMT\ for\ Existing\ Customers}}{CDL_{on\ PMT\ for\ Existing\ Customers}}$$

Then evaluation for the criteria (Loading % , Voltage Drop %) should be based on summation of MD on PMT and the corrected CDL of concerned new customer.

9.0 STEP BY STEP DESIGN PROCEDURES

1. Connected Load (CL) in (KVA) for each Individual unit in customer's building should be estimated, unit by unit, referring to SEC Distribution Planning Standards No.(DPS-01, Rev. 02) titled (Estimation Of Customer Load Guideline) with its latest updates.
2. Individual Circuit Breaker Rating (CBR) in (Amp) for the Individual KWH Meter for each Individual unit in customer's building should be determined according to the estimated connected load (CL) of that Individual unit and referring to SEC Distribution Planning Standards No.(DPS-01, Rev. 02) titled (Estimation of Customer Load Guideline) with its latest updates.
3. Number of Individual KWH Meters (N) required for the customer's building should be determined according to number of Individual units in customer's building and referring to SEC Customer Services Manual with its latest updates.
4. Calculate the Coincident Demand Load (CDL) in (Amp) for the group of all KWH Meters of the customer's building as follows :

$$CDL = \left(\sum_{i=1}^{N} CBR_i \times DF_i \right) \times CF(N)$$

Where :

N = Number of Individual KWH Meters required for the customer's building.

CBR_i = Circuit Breaker Rating in (Amp) for the Individual KWH Meter no. (i).

DF_i = Demand Factor for the Individual KWH Meter no. (i) which should be determined according to the utilization nature of the concerned Individual unit no. (i) in customer's building and referring to SEC Distribution Planning Standards No.(DPS-01, Rev. 02) titled (Estimation of Customer Load Guideline) with its latest updates.

$CF(N)$ = Coincident Factor for the group of all KWH Meters of the customer's building which should be determined according to Number of these KWH Meters (N) and referring to SEC Distribution Planning Standards No.(DPS-01, Rev. 02) titled (Estimation of Customer Load Guideline) with its latest updates.

$$CF(N) = \frac{\left(0.67 + \frac{0.33}{\sqrt{N}}\right)}{1.25}$$

$$For\ N = 1 \Rightarrow CF(N) = 1$$

Note :

For a group of (N) KWH Meters in the customer's building where all of them have same Circuit Breaker Rating (CBR) in (Amp) and same Demand Factor (DF), the equation to calculate the Coincident Demand Load (CDL) in (Amp) for this group of KWH Meters could be simplified as follows :

$$CDL = N \times CBR \times DF \times CF(N)$$

Note :

For a group of (N) KWH Meters in the customer's building where any one of them has different Circuit Breaker Rating (CBR) in (Amp), the equation to calculate the Coincident Demand Load (CDL) in (Amp) for this group of KWH Meters will be as follows :

$$CDL = \left[CBR_{\substack{Largest\\Meter}} \times DF_{\substack{Largest\\Meter}}\right] + \left[\left(\sum_{i=1}^{N-1} CBR_i \times DF_i\right) \times CF(N-1)\right]$$

5. Calculate the Coincident Demand Load (CDL) in (KVA) of the customer's building from the calculated Coincident Demand Load (CDL) in (Amp) as follows :

$$CDL_{in\ KVA} = \frac{CDL_{in\ AMP} \times V_{LL} \times \sqrt{3}}{1000}$$

Where :

V_{LL} = Nominal Voltage (line to line) of the LV Network (in volts).

This equation can be simplified as follows :

$$CDL_{in\ KVA} = \frac{CDL_{in\ AMP}}{F_{Conversion}}$$

Where :

$F_{Conversion}$ = Conversion Factor to convert (CDL) from (Amp) to (KVA). Its values for different nominal voltages are shown in the following Table (24) below.

Table (24)

Conversion Factor $F_{Conversion}$	Standard Nominal Voltages (V)		
	400	**380**	**220**
	1.443	1.519	2.624

6. Based on the calculated Coincident Demand Load (CDL) in (Amp) of the customer's building , select the suitable connection configuration type to supply this Coincident Demand Load (CDL) as shown in Table (25) hereunder. the suitable connection configuration type includes :
   - Size of conductor to customer.
   - No. of conductors to customer required.
   - Suitable supply source : Direct Feeder from PMT or Service Drop through LV Main Feeder.
   - No. of outgoing required.

Table (25)

Coincident Demand Load (Amps)		Coincident Demand Load (KVA) for Different Voltages (V) – Standard Nominal Voltages (V)						Supply Source	No. of Outgoing MCCBs	No. of LV Conductors to Customer	Size of LV Conductors to Customer	Main OH LV Feeder	
		400 V		380 V		220 V						No. of Conductors to OH	Conductor Size
From	To	From	To	From	To	From	To						
1	**88**	1	61	1	58	0	34	**PMTDC**	1	1	50 mm^2	1	120 mm^2
89	**160**	62	111	59	105	34	61	**PMTDC**	1	1	120 mm^2	1	120 mm^2
161	**176**	112	122	106	116	61	67	**PMTDC**	2	2	50 mm^2	2	120 mm^2
177	**320**	123	222	116	211	67	122	**PMTDC**	2	2	120 mm^2	2	120 mm^2
1	**108**	1	75	1	71	0	41	**PMTDC**	1	1	70 mm^2	1	120 mm^2
109	**160**	76	111	72	105	42	61	**PMTDC**	1	1	185 mm^2	1	120 mm^2
161	**216**	112	150	106	142	61	82	**PMTDC**	2	2	70 mm^2	2	120 mm^2
217	**320**	150	222	143	211	83	122	**PMTDC**	2	2	185 mm^2	2	120 mm^2
1	**108**	1	75	1	71	0	41	**PMTDC**	1	1	70 mm^2	Direct UG Feeder	
109	**184**	76	127	72	121	42	70	**PMTDC**	1	1	185 mm^2	Direct UG Feeder	
185	**216**	128	150	122	142	70	82	**PMTDC**	2	2	70 mm^2	Direct UG Feeder	
217	**368**	150	255	143	242	83	140	**PMTDC**	2	2	185 mm^2	Direct UG Feeder	

7. If the suitable connection configuration type is Service Drop through LV Main Feeder , go to the next step.
8. First try to supply customer's CDL from existing nearby LV Main Feeder by using the following steps :
   a. Select the nearest existing LV Main Feeder to the customer's location (as possible).
   b. Calculate CDL on the LV Main Feeder (120 mm^2 cable) including of all customers KWH Meters (concerned new customer + existing customers) supplied from this LV Main Feeder.

c. CDL on the LV Main Feeder should be not greater than LV Main Feeder's Firm Capacity (i.e. not exceeding 80 % of LV Main Feeder's rating).
d. Calculate CDL on the PMT including of all customers KWH Meters (concerned new customer + existing customers) supplied from this PMT.
e. CDL on the PMT should be not greater than PMT's Firm Capacity (i.e. not exceeding 80 % of PMT's rating).
f. Select the shortest geographic route for the Service Drop from LV Main Feeder to customer's location (as possible).
g. Calculate VD% on the LV Main Feeder (120 mm^2 cable) from PMT to customer's location.
h. Calculate VD% on the Service Drop from LV Main Feeder to customer's location.
i. Calculate the Total VD% from PMT to customer's location.
j. Total VD% from PMT to customer's location should be not greater than voltage drop limit (i.e. not exceeding 5 %).
k. If customer's CDL cannot be supplied from the selected LV Main Feeder because one of the criteria (Loading % , Voltage Drop %) is not satisfied , Try all others nearby existing LV Main Feeders (one by one) with priority for the nearest and by using same steps in above (from "a" to "j").

9. If customer's CDL cannot be supplied from all nearby existing LV Main Feeders because one of the criteria (Loading % , Voltage Drop %) is not satisfied , go to the next step.
10. Try to supply customer's CDL from existing nearby PMT through a new LV Main Feeder by using the following steps :
    a. Select the nearest existing PMT to the customer's location (as possible).
    b. Calculate CDL on the PMT including of all customers KWH Meters (concerned new customer + existing customers) supplied from this PMT.
    c. CDL on the PMT should be not greater than PMT's Firm Capacity (i.e. not exceeding 80 % of PMT's rating).
    d. Select the shortest geographic route for the new LV Main Feeder (120 mm^2 cable) from PMT to the customer's location (as possible).
    e. Select the shortest geographic route for the Service Drop from the new LV Main Feeder to customer's location (as possible).
    f. Calculate VD% on the new LV Main Feeder (120 mm^2 cable) from PMT to customer's location.
    g. Calculate VD% on the Service Drop from the new LV Main Feeder to customer's location.
    h. Calculate the Total VD% from PMT to customer's location.

i. Total VD% from PMT to customer's location should be not greater than voltage drop limit (i.e. not exceeding 5 %).
j. If customer's CDL cannot be supplied from the selected PMT because one of the criteria (Loading % , Voltage Drop %) is not satisfied , Try all others nearby existing PMT (one by one) with priority for the nearest and by using same steps in above (from "a" to "i").

11. If customer's CDL cannot be supplied from all nearby existing PMT because one of the criteria (Loading % , Voltage Drop %) is not satisfied , go to the next step.
12. Design to supply customer's CDL from a new PMT through a new LV Main Feeder by using the following steps :
    a. Design to install a new PMT near to customers lots in the center of loads area (including : concerned new customer , existing others nearby supply requests , nearby under constructions buildings , empty lots) as possible.
    b. Size (KVA rating) of the new PMT should be selected based on the need of the neighbor area (including : concerned new customer , existing others nearby supply requests , nearby under constructions buildings , existing empty lots).
    c. Select the shortest geographic route for the new LV Main Feeder (120 mm^2 cable) from the new PMT to the customer's location (as possible).
    d. Select the shortest geographic route for the Service Drop from the new LV Main Feeder to customer's location (as possible).
    e. Calculate VD% on the new LV Main Feeder (120 mm^2 cable) from the new PMT to customer's location.
    f. Calculate VD% on the Service Drop from the new LV Main Feeder to customer's location.
    g. Calculate the Total VD% from the new PMT to customer's location.
    h. Total VD% from the new PMT to customer's location should be not greater than voltage drop limit (i.e. not exceeding 5 %).
13. If the suitable connection configuration type is Direct Feeder from PMT , go to the next step.
14. First try to supply customer's CDL from existing nearby PMT by using the following steps :
    a. Select the nearest existing PMT to the customer's location (as possible).
    b. Calculate CDL on the PMT including of all customers KWH Meters (concerned new customer + existing customers) supplied from this PMT.
    c. CDL on the PMT should be not greater than PMT's Firm Capacity (i.e. not exceeding 80 % of PMT's rating).

d. Select the shortest geographic route for the Direct Feeder from PMT to the customer's location (as possible).
e. Calculate VD% on the Direct Feeder from PMT to the customer's location.
f. Total VD% from PMT to customer's location should be not greater than voltage drop limit (i.e. not exceeding 5 %).
g. If customer's CDL cannot be supplied from the selected PMT because one of the criteria (Loading % , Voltage Drop %) is not satisfied , Try all others nearby existing PMTs (one by one) with priority for the nearest and by using same steps in above (from "a" to "f").

15. If customer's CDL cannot be supplied from all nearby existing PMTs because one of the criteria (Loading % , Voltage Drop %) is not satisfied , go to the next step.
16. Design to supply customer's CDL from a new PMT by using the following steps :
    a. Design to install a new PMT near to customers lots in the center of loads area (including : concerned new customer , existing others nearby supply requests , nearby under constructions buildings , empty lots) as possible.
    b. Size (KVA rating) of the new PMT should be selected based on the need of the neighbor area (including : concerned new customer , existing others nearby supply requests , nearby under constructions buildings , existing empty lots).
    c. Select the shortest geographic route for the Direct Feeder from the new PMT to the customer's location (as possible).
    d. Calculate VD% on the Direct Feeder from the new PMT to the customer's location.
    e. Total VD% from the new PMT to customer's location should be not greater than voltage drop limit (i.e. not exceeding 5 %).

10.0 LV OH CONDUCTORS DE-RATING FACTORS

LV OH Conductors Ratings given in Table (7) are based on SEC Standard conditions mentioned in Table (9). For any other different conditions , the LV OH Conductors ratings will be different accordingly and will be corrected by applying the De-rating Factors mentioned in Table (26) & Table (27) & Table (28) & Table (29) by using the following equation :

$$\begin{aligned} &\text{Corrected LV OH Conductor Rating} \\ &\quad = \text{LV OH Conductor Rating given in Table (7)} \\ &\quad \times \text{Ambient Temperature Correction Factor} \\ &\quad \times \text{Altitude Correction Factor} \\ &\quad \times \text{Wind Velocity Correction Factor} \\ &\quad \times \text{Conductor Temperature Correction Factor} \end{aligned}$$

Table (26)

Ambient Temperature Correction Factors

Ambient Air Temperature - °C.	*Correction Factor*
45	1.10
50	1.00
55	0.88

Table (27)

Altitude Correction Factors

Altitude – m	*Correction Factor*
0	1.05
1000	1.00
2000	0.95
3000	0.90

Table (28)

Wind Velocity Correction Factors

Wind Velocity – m/sec.	*Correction Factor*
Natural Convection	0.60
0.6	1.00
1.0	1.15
2.0	1.38
5.0	1.80

Table (29)

Conductor Temperature Correction Factors

Conductor Temperature - °C	*Correction Factor*
75	0.88
80	1.00
85	1.10
90	1.19
120	1.60

Note: *Conductors shall be operated at temperatures in excess of the standard maximum operating temperature of 80 °C. only where: The line has been designed such that all clearances are observed at the higher conductor temperature and The suppliers confirm that the conductor and all accessories are capable of operation without sustaining damage at the higher conductor temperature. Any period of operation at higher conductor temperatures shall be limited to within the supplier's recommendation.*

This concludes that the Corrected De-rated Capacity of LV OH Conductors based on SEC Standard Service Conditions are as shown in Table (30).

Table (30)

LV Conductors Size	Corrected De-rated Capacity (Amps)
4 X 120 mm² AL, Quadruplex	200
4 X 50 mm² AL, Quadruplex	110

11.0 SUPPLY METHOD FOR LV LARGE METERS (300 , 400 , 500 , 600 , 800 AMP)

The following Tables (Table 34 & Table 35) show the supply method for LV Large Meters (300 , 400 , 500 , 600 , 800 Amp) in Overhead LV Networks for different Demand Load Type by applying the design principles described in Section No. (8.0) and taking in consideration the following points :

1) The LV Conductors/Cables Rating :

Table (31)

Conductors/Cables Size	Rating	1 Conductor/Cable	2 Conductors/Cables
		Max	Max
mm2	Amp	Amp	Amp
120 mm² Quadruplex	200	200	400
50 mm² Quadruplex	110	110	220
185 mm² Cable	230	230	460
70 mm² Cable	135	135	270

2) The PMT Cabinet's Firm Capacity and the rating of outgoing MCCB of the PMT Cabinet :

Table (32)

PMT Cabinet	PMT Cabinet	PMT Cabinet	PMT Cabinet
Full Rating	Firm Capacity	1 Outgoing MCCB Rating	2 Outgoings MCCBs Rating
(Amp)	(Amp)	(Amp)	(Amp)
800	640	200	400

3) The capability of Conductors/Cables connections to the outgoings of the PMT Cabinet and the capability of Conductors connections as service drop and the capability of Cable connections to the incomings of the Meter Boxes (300 , 400 , 500 , 600 Amp) and Service Cabinet for (800 Amp) Meter :

Table (33)

Connection Point	Capability of Cable Connections
Outgoings of the PMT Cabinet	1 Quadruplex Conductor Up to 120 mm^2 per Outgoing Or 1 Cable Up to 185 mm^2 per Outgoing
Conductors Connections as Service Drop	1 Quadruplex Conductor Up to 120 mm^2 per circuit
Meter Box 300 Amp	Two Incomings Up to 1 Cable 300 mm^2 + 1 Cable 185 mm^2
Meter Box 400 Amp	Two Incomings Up to 1 Cable 300 mm^2 + 1 Cable 185 mm^2
Meter Box 500 Amp	Two Incomings Up to 1 Cable 300 mm^2 per incoming
Meter Box 600 Amp	Two Incomings Up to 1 Cable 300 mm^2 per incoming
Service Cabinet (800 Amp) Meter	Two Incomings Up to 1 Cable 300 mm^2 per incoming

Also the following Tables (Table 34 & Table 35) created for two Scenarios :

A. Using of OHL Service Drop Connection Configuration
B. Using of UG Service Connection Configuration

The planning engineer should study the supply request according to these options and evaluate the cost and the voltage drop for each one then to select the suitable option and the most economical one.

The supply method for these types of meters need special configurations design as follows :

(a) Two Outgoings from PMT Cabinet through two OHL LV Feeders with two Service Drop Connections to Meter Box

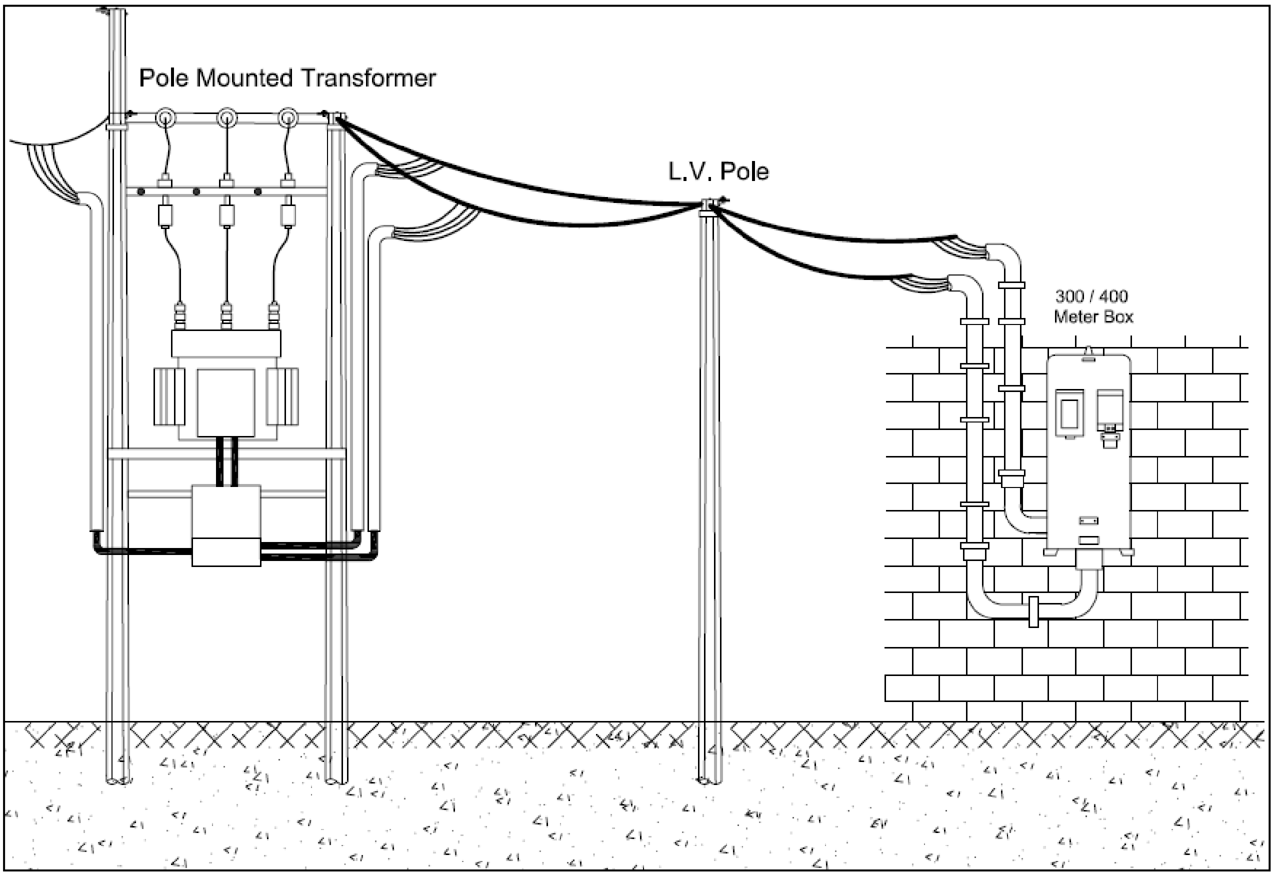


Figure (4)

(b) Two Outgoings from PMT Cabinet through two OHL LV Feeders with two LV UG Service Cable to Meter Box

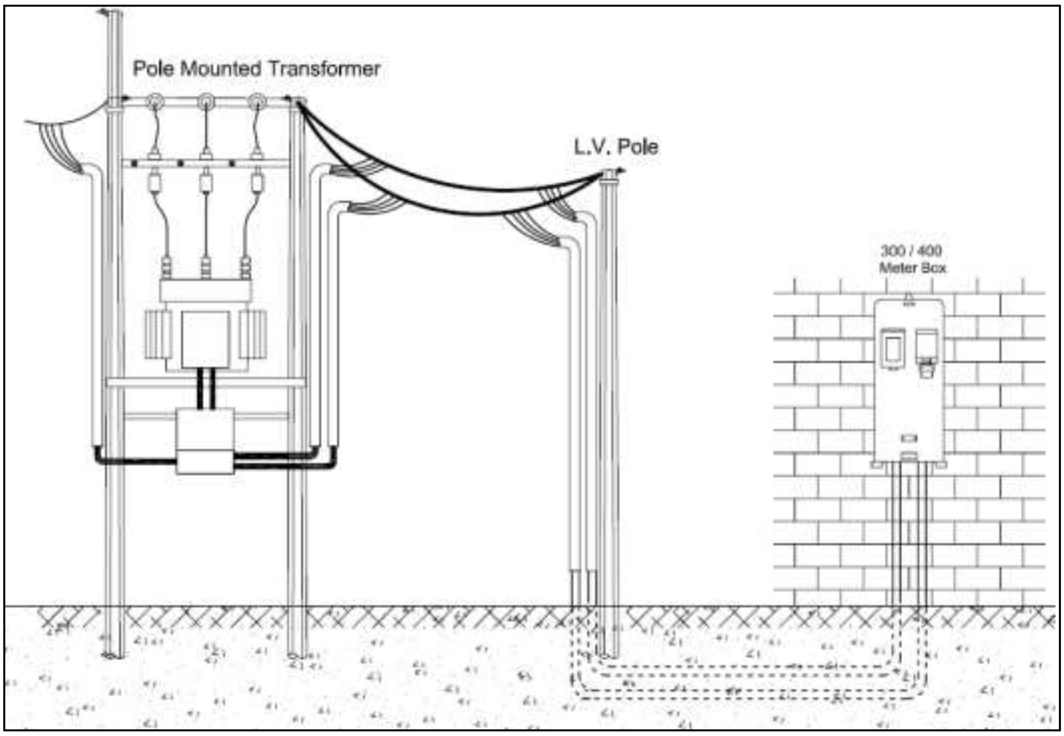


Figure (5)

(c) Two Outgoings from PMT Cabinet through two LV UG Direct Cables to Meter Box

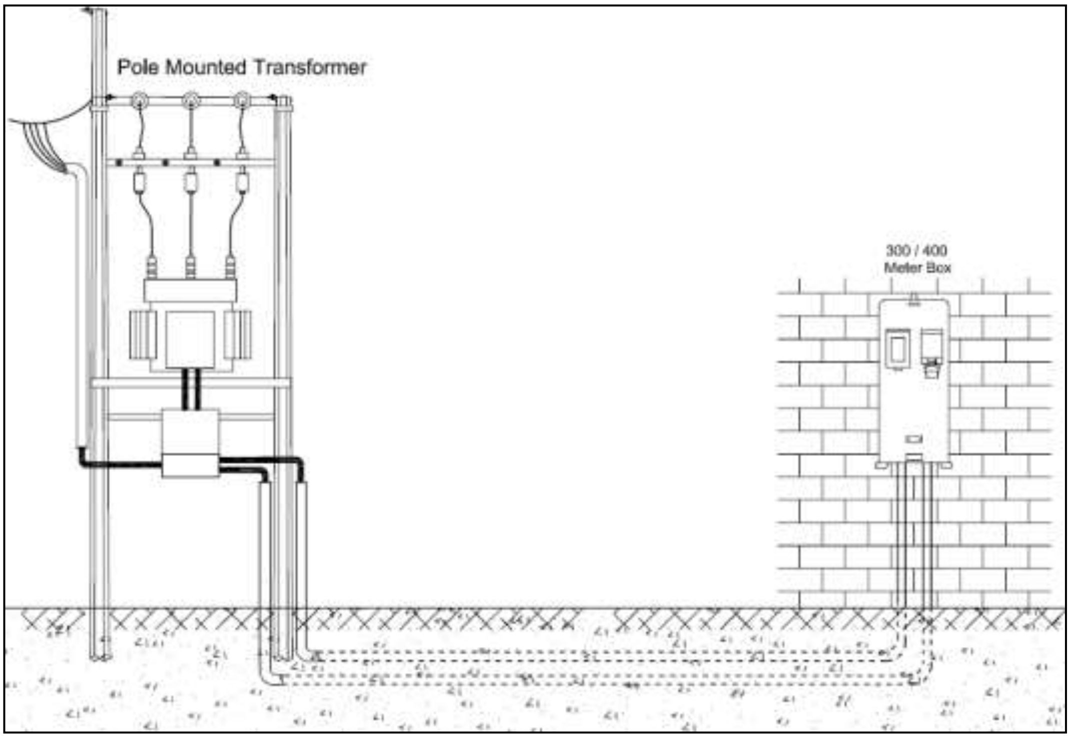


Figure (6)

11.1 SUPPLY METHOD FOR 300 AMP LV METER

Table (34)

Limitation Scenario			Option 1 Using of 2 Outgoings & 2 OH Service Drop				Option 2 Using of 2 Outgoings & 2 UG Service Cable			
CB Rating (Amp)	DF	Demand Load (Amp)	Supply Source	No. of Outgoings	No. of Conductors	Service Drop Conductor Size (mm2)	Supply Source	No. of Outgoings	No. of Cables	UG Service Cable Size (mm2)
300	0.5	150	2 OH MAIN LV 120 mm²	2	2	50	2 OH MAIN LV 120 mm²	2	2	70
300	0.6	180	2 OH MAIN LV 120 mm²	2	2	50	2 OH MAIN LV 120 mm²	2	2	70
300	0.7	210	2 OH MAIN LV 120 mm²	2	2	50	2 OH MAIN LV 120 mm²	2	2	70
300	0.8	240	2 OH MAIN LV 120 mm²	2	2	120	2 OH MAIN LV 120 mm²	2	2	70
300	0.9	270	2 OH MAIN LV 120 mm²	2	2	120	2 OH MAIN LV 120 mm²	2	2	70

PMTC = Pole Mounted Transformer Cabinet
OH MAIN LV = OHL Main LV Feeder (Quadruplex Conductor)

11.2 SUPPLY METHOD FOR 400 AMP LV METER

Table (35)

Limitation Scenario			Option 1 Using of 2 Outgoings & 2 OH Service Drop				Option 2 Using of 2 Outgoings & 2 UG Service Cable			
CB Rating (Amp)	DF	Demand Load (Amp)	Supply Source	No. of Outgoings	No. of Conductor	Service Drop Conductor Size (mm2)	Supply Source	No. of Outgoings	No. of Cables	UG Service Cable Size (mm2)
400	0.5	200	2 OH MAIN LV 120 mm²	2	2	50	2 OH MAIN LV 120 mm²	2	2	70
400	0.6	240	2 OH MAIN LV 120 mm²	2	2	120	2 OH MAIN LV 120 mm²	2	2	70
400	0.7	280	2 OH MAIN LV 120 mm²	2	2	120	2 OH MAIN LV 120 mm²	2	2	185
400	0.8	320	2 OH MAIN LV 120 mm²	2	2	120	2 OH MAIN LV 120 mm²	2	2	185
400	0.9	360	2 OH MAIN LV 120 mm²	2	2	120	2 OH MAIN LV 120 mm²	2	2	185

11.3 SUPPLY METHOD FOR 500 AMP LV METER

The 500 Amp LV Meter cannot be supplied by Pole Mounted Transformer Cabinet Configuration. Because the Max capacity of supply can be get from two outgoings MCCBs of PMT LV Cabinet is 400 A and only two incomings can be connected to the 500 A Meter Box.
To supply 500 Amp LV Meter in OHL Network , use the Underground configuration described in SEC Distribution Planning Standards No. (DPS-02, Rev.02) named (Design Guideline of Underground Low Voltage Network to Supply Customers).

11.4 SUPPLY METHOD FOR 600 AMP LV METER

The 600 Amp LV Meter cannot be supplied by Pole Mounted Transformer Cabinet Configuration. Because the Max capacity of supply can be get from two outgoings MCCBs of PMT LV Cabinet is 400 A and only two incomings can be connected to the 600 A Meter Box.
To supply 600 Amp LV Meter in OHL Network , use the Underground configuration described in SEC Distribution Planning Standards No. (DPS-02, Rev.02) named (Design Guideline of Underground Low Voltage Network to Supply Customers).

11.5 SUPPLY METHOD FOR 800 AMP LV METER

The 800 Amp LV Meter cannot be supplied by Pole Mounted Transformer Cabinet Configuration. Because the Max capacity of supply can be get from two outgoings MCCBs of PMT LV Cabinet is 400 A and only two incomings can be connected to the 800 A Service Cabinet.
To supply 800 Amp LV Meter in OHL Network , use the Underground configuration described in SEC Distribution Planning Standards No. (DPS-02, Rev.02) named (Design Guideline of Underground Low Voltage Network to Supply Customers).

12.0 SUPPLY METHOD FOR LV CUSTOMERS WITH LOAD MORE THAN 800 AMP BY PRIVATE / DEDICATED DISTRIBUTION TRANSFORMERS

Supplying of LV Customers by Private/ Dedicated Transformers can be used for the following major cases :

1) When the demand load of the customer's unit is more than 800 Amp and the customer building is considered as one unit according to Customer Services Manual and according to municipality permits.
2) When there is no other customer can be supplied from the proposed Transformer and the demand load of the customer's unit is 300 KVA or more and the customer building is considered as one unit according to Customer Services Manual and according to municipality permits.
3) When the customer ask for Private / Dedicated Transformers for any specific reason.

In Overhead Network these cases cannot be supplied by Pole Mounted Transformer configuration. Because there is no special overhead distribution materials specified for this type of supply to be sufficient for that kind of design. (e.g. there is no main circuit breaker for PMT LV Cabinet).
To supply these cases in Overhead Network, use the Underground configuration described in SEC Distribution Planning Standards No. (DPS-02, Rev.02) named (Design Guideline of Underground Low Voltage Network to Supply Customers).

13.0 SPECIAL CASE : LV NETWORK FOR RANDOM AREA

The Random Area is the area which is considered as un-planned area according to the municipality and which has many buildings without construction permits from the municipality. Usually in this area type, the un-permitted buildings get the supply illegally from the permitted buildings. For these areas with this type, the design of its Overhead LV Networks should be based on the following special considerations :

1. The Demand Factor (DF) is 1.0.
2. The Coincident Factor (CF) is 0.8.

14.0 SPECIAL CASE : LV NETWORK FOR COMMERCIAL CENTER

The Commercial Center or any group of commercial shops which apply common working time so that all its shops are to be opened and closed at the same time , for this type of commercial shops , the design of its Overhead LV Networks should be based on the following special considerations :

1. The Demand Factor (DF) is 0.7.
2. The Coincident Factor (CF) is 1.0.

15.0 SPECIAL CASE : COINCIDENT DEMAND LOAD CALCULATION FOR COMMERCIAL OFFICES BUILDINGS

The Commercial Offices Building which apply common working time so that all its Offices are to be opened and closed at the same time , for this type of commercial Offices, the Calculation of Coincident Demand Load should be based on the following special considerations :

1. The Coincident Factor (CF) is 1.0.
2. The Demand Factor (DF) is 0.7

16.0 SPECIAL CASE : COINCIDENT DEMAND LOAD CALCULATION FOR COMPLEX OF WORKSHOPS

The Complex Of Workshops which apply common working time so that all its Workshops are to be opened and closed at the same time , for this type of Workshops, the Calculation of Coincident Demand Load should be based on the following special considerations :

1. The Coincident Factor (CF) is 1.0.
2. The Demand Factor (DF) is 0.9.

17.0 REINFORCEMENT OF OVERHEAD LOW VOLTAGE NETWORK

Principles and procedures for Reinforcement of Low Voltage Overhead Network will be in a separate special Guideline which is under preparing by DPS Committee.

18.0 ADVANTAGEOUS MODULES AND TABLES

Software Modules are already built in EXCEL format and attached in the Appendixes for the following subjects :

a) Design of Overhead Low Voltage Network (Appendix A1).
b) Design of PMTs required to supply an Area (Appendix A2).

Also Advantageous Tables are already built in EXCEL format and attached in the Appendix for the following subjects :

a) No. of Meters can be supplied by (PMT , LV Conductors) for different Demand Factors (0.6 , 0.7 , 0.8 , 0.9) and for different CB Ratings (20 , 30 , 40 , 50 , 70 , 100 , 125 , 150 , 200 , 250 , 300 , 400 A) in different Nominal Voltages (400 , 380 , 220 V). (Appendix A3 , A4 , A5 , A6 , A7 , A8)
b) Max Lengths (m) can be achieved within allowed Voltage Drop (5% , 3.5% , 1.5%) in different Nominal Voltages (400 , 380 , 220 V) with different LV Conductors' Sizes (120 , 50 mm^2) for different Coincident Demand Load.
   (Appendix A9 , A10 , A11)
c) Voltage Drop (%) in different Nominal Voltages (400 , 380 , 220 V) with different LV Cables' Sizes (300 , 185 , 70 mm^2) for different Coincident Demand Load (KVA) with different Cables' Length (m).
   (Appendix A12 , A13 , A14 , A15 , A16 , A17)
d) Demand Factor Values (Appendix A18)
e) Coincident Factor Values (Appendix A19)

19.0 TYPICAL LAYOUT FOR OVERHEAD LOW VOLTAGE NETWORK

Typical layout for design of Overhead Low Voltage Network with typical location of Pole Mounted Transformers at center of load is illustrated in the following drawing in Figure (7) below.

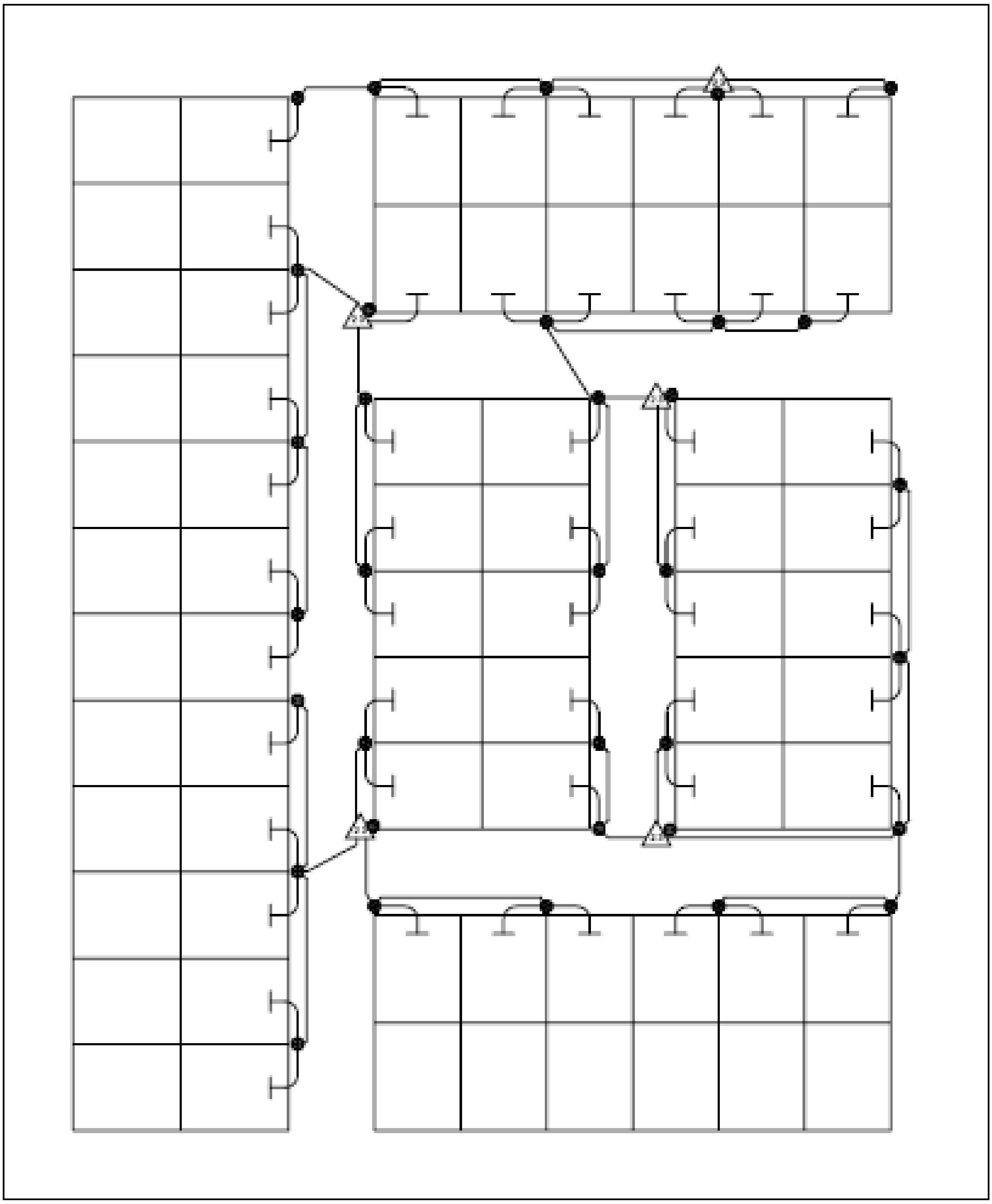


Figure (7)

20.0 TYPICAL DISTRIBUTED LOADS PER OUTGOING OF THE PMT LV CABINET

Table (36) shows the typical distributed loads per outgoing of the PMT LV Cabinet to reach full utilization of PMT's firm capacity for different ratings of PMTs (50 , 100 , 200 , 300 KVA) and for different nominal voltages (400 , 380 , 220 V).

Table (36)

Secondary Voltage	Transformer Rating	PMT LV Cabinet Rating	Number of Outgoing MCCB's	Transformer Rating	Load per Outgoing
(V)	(KVA)	(A)		(A)	(A)
400	**50**	400	2	72	**36**
400	**100**	400	2	144	**72**
400	**200**	800	4	289	**72**
400	**300**	800	4	433	**108**
380	**50**	400	2	76	**38**
380	**100**	400	2	152	**76**
380	**200**	800	4	304	**76**
380	**300**	800	4	456	**114**
220	**50**	400	2	131	**66**
220	**100**	400	2	262	**131**
220	**200**	800	4	525	**131**
220	**300**	800	4	787	**197**

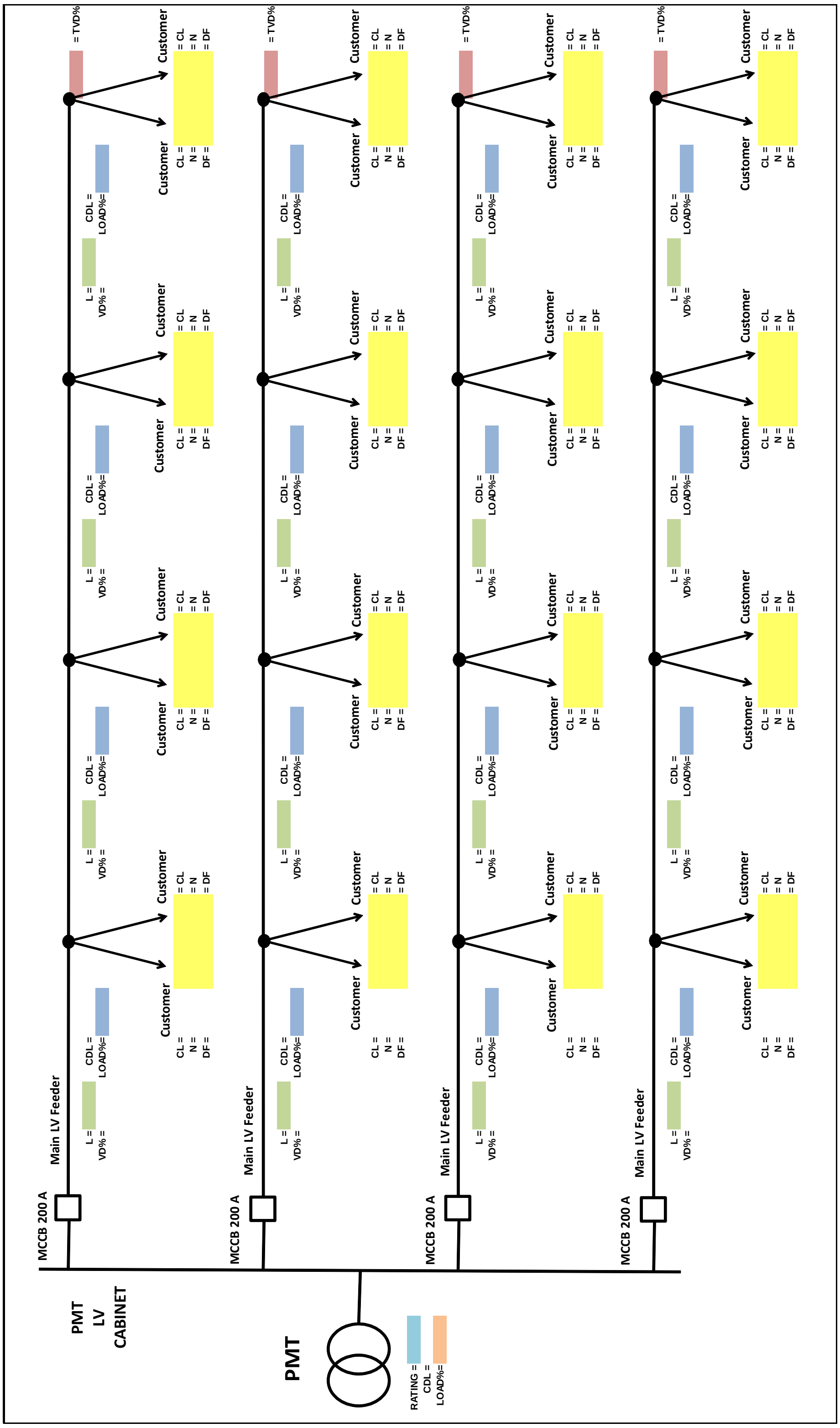
APPENDIXES

A1. MODULE FOR DESIGN OF OVERHEAD LOW VOLTAGE NETWORK
A2. MODULE FOR DESIGN OF PMTs REQUIRED TO SUPPLY AN AREA
A3. TABLE FOR NO. OF METERS CAN BE SUPPLIED BY (LV CONDUCTORS)
A4. TABLE FOR NO. OF METERS CAN BE SUPPLIED BY (PMT 400 V)
A5. TABLE FOR NO. OF METERS CAN BE SUPPLIED BY (PMT 380 V)
A6. TABLE FOR NO. OF METERS CAN BE SUPPLIED BY (PMT 220 V)
A7. TABLE FOR NO. OF METERS CAN BE SUPPLIED (IN RANDOM AREA)
A8. TABLE FOR NO. OF METERS CAN BE SUPPLIED (FOR COMMERCIAL CENTER)
A9. TABLE FOR MAX LENGTHS WITHIN (5%) VOLTAGE DROP
A10. TABLE FOR MAX LENGTHS WITHIN (3.5%) VOLTAGE DROP
A11. TABLE FOR MAX LENGTHS WITHIN (1.5%) VOLTAGE DROP
A12. TABLE FOR VOLTAGE DROP (%) IN (400 V) WITH (120 MM^2 CONDUCTOR)
A13. TABLE FOR VOLTAGE DROP (%) IN (400 V) WITH (50 MM^2 CONDUCTOR)
A14. TABLE FOR VOLTAGE DROP (%) IN (380 V) WITH (120 MM^2 CONDUCTOR)
A15. TABLE FOR VOLTAGE DROP (%) IN (380 V) WITH (50 MM^2 CONDUCTOR)
A16. TABLE FOR VOLTAGE DROP (%) IN (220 V) WITH (120 MM^2 CONDUCTOR)
A17. TABLE FOR VOLTAGE DROP (%) IN (220 V) WITH (50 MM^2 CONDUCTOR)
A18. TABLE FOR DEMAND FACTOR VALUES
A19. TABLE FOR COINCIDENT FACTOR VALUES
A20. REFERENCES

A1. MODULE FOR DESIGN OF OVERHEAD LOW VOLTAGE NETWORK

This Software Module is already built in EXCEL format. It makes all the calculations of Voltage Drop and Loading Percentage on LV Conductors and Pole Mounted Transformers , required for design of Overhead Low Voltage Network.

Module for Design of Overhead Lines LV Network



A2. MODULE FOR DESIGN OF PMTs REQUIRED TO SUPPLY AN AREA

This Software Module is already built in EXCEL format. It makes the calculations to estimate No. of PMTs with a certain rating required to supply an area .

Module for Design of PMTs Required to Supply an Area :

PMT kVA =

Date: ##########

Plot Area (Average) (m2)	Construction Area (%)	Number of Floors	No. of Units in Each Plot	No. of Plots	Built-up Area (m2)	Load (KVA)	Total No. of Meters	Coincident Factor	Demand Load	Load on Substation (kVA)	%age Loading of PMT
					0.0	#N/A	0	#N/A	#N/A	#N/A	#N/A

Total No. of Plots in the Scheme	Total Area of Scheme (Plots only) (m2) NOT AVAILABLE	Enter 1 for Commercial, 0 for Residential			Plot Area (Average) (m2)						No of PMTs Required for the Scheme
					0.0						0

A3. TABLE FOR NO. OF METERS CAN BE SUPPLIED BY (LV CONDUCTORS)

This Table shows No. of Meters can be supplied by LV Conductors (120 , 50 mm^2) for different Demand Factors (0.6 , 0.7 , 0.8 , 0.9) and for different CB Ratings (20 , 30 , 40 , 50 , 70 , 100 , 125 , 150 , 200) A.

		120 mm^2 Conductor capacity =200 A				50 mm^2 Conductor capacity =110 A			
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%	
0.6	20	0.592	156	78	22	0.612	88	80	12
0.6	30	0.607	153	76	14	0.636	80	73	7
0.6	40	0.619	149	74	10	0.654	78	71	5
0.6	50	0.629	151	75	8	0.668	80	73	4
0.6	70	0.654	137	69	5	0.688	87	79	3
0.6	100	0.668	160	80	4	0.723	87	79	2
0.6	125	0.688	155	77	3	1.000	75	68	1
0.6	150	0.723	130	65	2				
0.6	200	1.000	120	60	1				
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%	
0.7	20	0.597	159	79	19	0.619	87	79	10
0.7	30	0.612	154	77	12	0.644	81	74	6
0.7	40	0.624	157	79	9	0.668	75	68	4
0.7	50	0.636	156	78	7	0.688	72	66	3
0.7	70	0.654	160	80	5	0.723	71	64	2
0.7	100	0.688	144	72	3	1.000	70	64	1
0.7	125	0.723	127	63	2	1.000	88	80	1
0.7	150	0.723	152	76	2				
0.7	200	1.000	140	70	1				
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%	
0.8	20	0.602	154	77	16	0.629	81	73	8
0.8	30	0.619	149	74	10	0.654	78	71	5
0.8	40	0.636	142	71	7	0.668	86	78	4
0.8	50	0.644	155	77	6	0.688	83	75	3
0.8	70	0.668	150	75	4	0.723	81	74	2
0.8	100	0.723	116	58	2	1.000	80	73	1
0.8	125	0.723	145	72	2				
0.8	150	1.000	120	60	1				
0.8	200	1.000	160	80	1				
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%	
0.9	20	0.607	153	76	14	0.636	80	73	7
0.9	30	0.624	152	76	9	0.654	88	80	5
0.9	40	0.636	160	80	7	0.688	74	68	3
0.9	50	0.654	147	74	5	0.723	65	59	2
0.9	70	0.688	130	65	3	1.000	63	57	1
0.9	100	0.723	130	65	2				
0.9	125	1.000	113	56	1				
0.9	150	1.000	135	68	1				
0.9	200								

A4. TABLE FOR NO. OF METERS CAN BE SUPPLIED BY (PMT 400 V)

This Table shows No. of Meters can be supplied by the PMTs in (400 V) LV Overhead Network for different Demand Factors (0.6 , 0.7 , 0.8 , 0.9) and for different CB Ratings (20 ,30 ,40 , 50 , 70 , 100 ,125 , 150 , 200 , 250 , 300 , 400) A.

		PMT 300 KVA 400V				PMT 200 KVA 400V				PMT 100KVA 400V				PMT 50 KVA 400V			
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%			A	%			A	%	
0.6	20	0.573	344	79	50	0.582	230	80	33	0.602	116	80	16	0.636	53	74	7
0.6	30	0.578	343	79	33	0.594	225	78	21	0.619	111	77	10	0.668	48	67	4
0.6	40	0.590	340	78	24	0.602	231	80	16	0.636	107	74	7	0.688	50	69	3
0.6	50	0.597	340	79	19	0.612	220	76	12	0.654	98	68	5	0.723	43	60	2
0.6	70	0.609	333	77	13	0.629	211	73	8	0.668	112	78	4	1.000	42	58	1
0.6	100	0.624	337	78	9	0.644	232	80	6	0.723	87	60	2				
0.6	125	0.636	334	77	7	0.668	200	69	4	0.723	108	75	2				
0.6	150	0.644	348	80	6	0.688	186	64	3	1.000	90	63	1				
0.6	200	0.668	321	74	4	0.723	174	60	2								
0.6	250	0.688	310	72	3	0.723	217	75	2								
0.6	300	0.723	260	60	2	1.000	180	62	1								
0.6	400	0.723	347	80	2												
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%			A	%			A	%	
0.7	20	0.576	347	80	43	0.586	230	79	28	0.609	111	77	13	0.644	54	75	6
0.7	30	0.586	345	80	28	0.598	226	78	18	0.629	106	73	8	0.668	56	78	4
0.7	40	0.595	333	77	20	0.609	222	77	13	0.644	108	75	6	0.688	58	80	3
0.7	50	0.602	337	78	16	0.619	217	75	10	0.654	114	79	5	0.723	51	70	2
0.7	70	0.616	332	77	11	0.636	218	75	7	0.688	101	70	3	1.000	49	68	1
0.7	100	0.636	312	72	7	0.654	229	79	5	0.723	101	70	2				
0.7	125	0.644	338	78	6	0.688	181	62	3	1.000	88	61	1				
0.7	150	0.654	343	79	5	0.688	217	75	3	1.000	105	73	1				
0.7	200	0.688	289	67	3	0.723	202	70	2								
0.7	250	0.723	253	58	2	1.000	175	61	1								
0.7	300	0.723	304	70	2	1.000	210	73	1								
0.7	400	1.000	280	65	1												
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%			A	%			A	%	
0.8	20	0.579	343	79	37	0.590	227	78	24	0.616	108	75	11	0.654	52	73	5
0.8	30	0.590	340	78	24	0.602	231	80	16	0.636	107	74	7	0.688	50	69	3
0.8	40	0.598	344	80	18	0.616	217	75	11	0.654	105	73	5	0.723	46	64	2
0.8	50	0.607	340	79	14	0.629	201	70	8	0.668	107	74	4	0.723	58	80	2
0.8	70	0.624	314	73	9	0.644	216	75	6	0.688	116	80	3	1.000	56	78	1
0.8	100	0.644	309	71	6	0.668	214	74	4	0.723	116	80	2				
0.8	125	0.654	327	76	5	0.688	206	71	3	1.000	100	69	1				
0.8	150	0.668	321	74	4	0.723	174	60	2								
0.8	200	0.688	330	76	3	0.723	231	80	2								
0.8	250	0.723	289	67	2	1.000	200	69	1								
0.8	300	0.723	347	80	2												
0.8	400	1.000	320	74	1												
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%			A	%			A	%	
0.9	20	0.582	346	80	33	0.594	225	78	21	0.619	111	77	10	0.668	48	67	4
0.9	30	0.594	337	78	21	0.607	229	79	14	0.644	104	72	6	0.688	56	77	3
0.9	40	0.602	347	80	16	0.619	223	77	10	0.668	96	67	4	0.723	52	72	2
0.9	50	0.612	330	76	12	0.629	226	78	8	0.688	93	65	3	1.000	45	63	1
0.9	70	0.629	317	73	8	0.654	206	71	5	0.723	91	63	2				
0.9	100	0.644	348	80	6	0.688	186	64	3	1.000	90	63	1				
0.9	125	0.668	301	69	4	0.688	232	80	3	1.000	113	78	1				
0.9	150	0.688	279	64	3	0.723	195	68	2								
0.9	200	0.723	260	60	2	1.000	180	62	1								
0.9	250	0.723	325	75	2	1.000	225	78	1								
0.9	300	1.000	270	62	1												
0.9	400																

A5. TABLE FOR NO. OF METERS CAN BE SUPPLIED BY (PMT 380 V)

This Table shows No. of Meters can be supplied by the PMTs in (380 V) LV Overhead Network for different Demand Factors (0.6 , 0.7 , 0.8 , 0.9) and for different CB Ratings (20 ,30 ,40 , 50 , 70 , 100 ,125 , 150 , 200 , 250 , 300 , 400) A.

		PMT 300 KVA 380V				PMT 200 KVA 380V				PMT 100KVA 380V				PMT 50 KVA 380V			
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%			A	%			A	%	
0.6	20	0.572	364	80	53	0.581	244	80	35	0.602	116	76	16	0.629	60	79	8
0.6	30	0.581	366	80	35	0.592	234	77	22	0.616	122	80	11	0.654	59	77	5
0.6	40	0.589	353	78	25	0.602	231	76	16	0.629	121	79	8	0.688	50	65	3
0.6	50	0.595	357	78	20	0.609	238	78	13	0.644	116	76	6	0.723	43	57	2
0.6	70	0.607	357	78	14	0.624	236	78	9	0.668	112	74	4	0.723	61	80	2
0.6	100	0.624	337	74	9	0.644	232	76	6	0.723	87	57	2				
0.6	125	0.636	334	73	7	0.668	200	66	4	0.723	108	71	2				
0.6	150	0.644	348	76	6	0.668	240	79	4	1.000	90	59	1				
0.6	200	0.668	321	70	4	0.723	174	57	2								
0.6	250	0.688	310	68	3	0.723	217	71	2								
0.6	300	0.723	260	57	2	1.000	180	59	1								
0.6	400	0.723	347	76	2												
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%			A	%			A	%	
0.7	20	0.575	362	79	45	0.585	238	78	29	0.607	119	78	14	0.644	54	71	6
0.7	30	0.585	356	78	29	0.597	238	78	19	0.624	118	78	9	0.668	56	74	4
0.7	40	0.592	365	80	22	0.607	238	78	14	0.644	108	71	6	0.688	58	76	3
0.7	50	0.600	357	78	17	0.616	237	78	11	0.654	114	75	5	0.723	51	67	2
0.7	70	0.612	360	79	12	0.636	218	72	7	0.688	101	67	3	1.000	49	64	1
0.7	100	0.629	352	77	8	0.654	229	75	5	0.723	101	67	2				
0.7	125	0.644	338	74	6	0.668	234	77	4	1.000	88	58	1				
0.7	150	0.654	343	75	5	0.688	217	71	3	1.000	105	69	1				
0.7	200	0.688	289	63	3	0.723	202	67	2								
0.7	250	0.688	361	79	3	1.000	175	58	1								
0.7	300	0.723	304	67	2	1.000	210	69	1								
0.7	400	1.000	280	61	1												
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%			A	%			A	%	
0.8	20	0.578	361	79	39	0.588	245	80	26	0.612	118	77	12	0.654	52	69	5
0.8	30	0.588	367	80	26	0.602	231	76	16	0.629	121	79	8	0.688	50	65	3
0.8	40	0.597	363	80	19	0.612	235	77	12	0.654	105	69	5	0.723	46	61	2
0.8	50	0.604	362	79	15	0.624	225	74	9	0.668	107	70	4	0.723	58	76	2
0.8	70	0.619	347	76	10	0.644	216	71	6	0.688	116	76	3	1.000	56	74	1
0.8	100	0.636	356	78	7	0.668	214	70	4	0.723	116	76	2				
0.8	125	0.654	327	72	5	0.688	206	68	3	1.000	100	66	1				
0.8	150	0.668	321	70	4	0.723	174	57	2	1.000	120	79	1				
0.8	200	0.688	330	72	3	0.723	231	76	2								
0.8	250	0.723	289	63	2	1.000	200	66	1								
0.8	300	0.723	347	76	2	1.000	240	79	1								
0.8	400	1.000	320	70	1												
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%			A	%			A	%	
0.9	20	0.581	366	80	35	0.591	245	80	23	0.616	122	80	11	0.654	59	77	5
0.9	30	0.592	352	77	22	0.607	229	75	14	0.636	120	79	7	0.688	56	73	3
0.9	40	0.602	347	76	16	0.616	244	80	11	0.654	118	77	5	0.723	52	68	2
0.9	50	0.609	356	78	13	0.629	226	74	8	0.668	120	79	4	1.000	45	59	1
0.9	70	0.624	354	78	9	0.644	243	80	6	0.723	91	60	2				
0.9	100	0.644	348	76	6	0.668	240	79	4	1.000	90	59	1				
0.9	125	0.668	301	66	4	0.688	232	76	3	1.000	113	74	1				
0.9	150	0.668	361	79	4	0.723	195	64	2								
0.9	200	0.723	260	57	2	1.000	180	59	1								
0.9	250	0.723	325	71	2	1.000	225	74	1								
0.9	300	1.000	270	59	1												
0.9	400	1.000	360	79	1												

A6. TABLE FOR NO. OF METERS CAN BE SUPPLIED BY (PMT 220 V)

This Table shows No. of Meters can be supplied by the PMTs in (220 V) LV Overhead Network for different Demand Factors (0.6 , 0.7 , 0.8 , 0.9) and for different CB Ratings (20 ,30 ,40 , 50 , 70 , 100 ,125 , 150 , 200 , 250 , 300 , 400) A.

		PMT 300 KVA 220 V				PMT 200 KVA 220 V				PMT 100KVA 220 V				PMT 50 KVA 220 V			
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%			A	%			A	%	
0.6	20	0.563	628	80	93	0.570	417	79	61	0.602	209	80	29	0.607	102	78	14
0.6	30	0.570	626	79	61	0.578	416	79	40	0.616	211	80	19	0.624	101	77	9
0.6	40	0.575	621	79	45	0.584	420	80	30	0.607	204	78	14	0.644	93	71	6
0.6	50	0.580	626	79	36	0.591	408	78	23	0.616	203	77	11	0.654	98	75	5
0.6	70	0.589	618	78	25	0.624	419	80	16	0.629	211	80	8	0.688	87	66	3
0.6	100	0.600	612	78	17	0.616	407	77	11	0.654	196	75	5	0.723	87	66	2
0.6	125	0.609	594	75	13	0.624	421	80	9	0.668	200	76	4	1.000	75	57	1
0.6	150	0.616	610	77	11	0.636	401	76	7	0.688	186	71	3				
0.6	200	0.629	604	77	8	0.654	392	75	5	0.723	174	66	2				
0.6	250	0.644	580	74	6	0.668	401	76	4	1.000	150	57	1				
0.6	300	0.654	589	75	5	0.688	372	71	3								
0.6	400	0.688	495	63	3	0.723	347	66	2								
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%			A	%			A	%	
0.7	20	0.566	626	79	79	0.573	417	79	52	0.589	206	78	25	0.612	103	78	12
0.7	30	0.573	626	79	52	0.581	415	79	34	0.602	202	77	16	0.636	93	71	7
0.7	40	0.578	631	80	39	0.589	412	79	25	0.612	206	78	12	0.654	92	70	5
0.7	50	0.583	633	80	31	0.595	417	79	20	0.624	197	75	9	0.668	94	71	4
0.7	70	0.594	611	78	21	0.607	416	79	14	0.644	189	72	6	0.688	101	77	3
0.7	100	0.604	634	80	15	0.624	393	75	9	0.668	187	71	4	0.723	101	77	2
0.7	125	0.616	593	75	11	0.636	390	74	7	0.688	181	69	3	1.000	88	67	1
0.7	150	0.624	590	75	9	0.644	406	77	6	0.723	152	58	2				
0.7	200	0.636	623	79	7	0.668	374	71	4	0.723	202	77	2				
0.7	250	0.654	572	73	5	0.688	361	69	3	1.000	175	67	1				
0.7	300	0.668	561	71	4	0.723	304	58	2								
0.7	400	0.688	578	73	3	0.723	405	77	2								
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%			A	%			A	%	
0.8	20	0.568	627	80	69	0.575	414	79	45	0.592	208	79	22	0.619	99	76	10
0.8	30	0.575	621	79	45	0.584	420	80	30	0.607	204	78	14	0.644	93	71	6
0.8	40	0.581	632	80	34	0.592	417	79	22	0.619	198	75	10	0.654	105	80	5
0.8	50	0.587	634	80	27	0.600	408	78	17	0.629	201	77	8	0.688	83	63	3
0.8	70	0.598	603	76	18	0.612	411	78	12	0.654	183	70	5	0.723	81	62	2
0.8	100	0.609	633	80	13	0.629	403	77	8	0.688	165	63	3	1.000	80	61	1
0.8	125	0.619	619	79	10	0.644	386	74	6	0.688	206	78	3	1.000	100	76	1
0.8	150	0.629	604	77	8	0.654	392	75	5	0.723	174	66	2				
0.8	200	0.644	618	78	6	0.688	330	63	3	1.000	160	61	1				
0.8	250	0.668	534	68	4	0.688	413	79	3	1.000	200	76	1				
0.8	300	0.688	495	63	3	0.723	347	66	2								
0.8	400	0.723	463	59	2	1.000	320	61	1								
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%			A	%			A	%	
0.9	20	0.570	626	79	61	0.578	416	79	40	0.597	204	78	19	0.624	101	77	9
0.9	30	0.578	624	79	40	0.588	413	79	26	0.612	198	75	12	0.644	104	80	6
0.9	40	0.584	631	80	30	0.597	408	78	19	0.624	202	77	9	0.668	96	73	4
0.9	50	0.591	612	78	23	0.604	408	78	15	0.636	200	76	7	0.688	93	71	3
0.9	70	0.602	607	77	16	0.619	390	74	10	0.654	206	78	5	0.723	91	70	2
0.9	100	0.616	610	77	11	0.636	401	76	7	0.688	186	71	3	1.000	90	69	1
0.9	125	0.624	632	80	9	0.654	368	70	5	0.723	163	62	2				
0.9	150	0.636	601	76	7	0.668	361	69	4	0.723	195	74	2				
0.9	200	0.654	589	75	5	0.688	372	71	3	1.000	180	68	1				
0.9	250	0.668	601	76	4	0.723	325	62	2								
0.9	300	0.688	557	71	3	0.723	390	74	2								
0.9	400	0.723	521	66	2	1.000	360	69	1								

A7. TABLE FOR NO. OF METERS CAN BE SUPPLIED (IN RANDOM AREA)

This Table shows No. of Meters can be supplied by PMTs and LV Conductors in Random Area for different Nominal Voltages (400 , 380 , 220 V) and for different CB Ratings (20 ,30 ,40 , 50 , 70 , 100 ,125 , 150 , 200 , 250 , 300 , 400) A.

		120 mm² Conductor capacity =200 A				50 mm² Conductor capacity =110 A			
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%	
1	20	0.80	160	80	10	0.80	80	73	5
1	30	0.80	144	72	6	0.80	72	65	3
1	40	0.80	160	80	5	0.80	64	58	2
1	50	0.80	160	80	4	0.80	80	73	2
1	70	0.80	112	56	2	0.80	56	51	1
1	100	0.80	160	80	2	0.80	80	73	1
1	125	0.80	100	50	1				
1	150	0.80	120	60	1				
1	200	0.80	160	80	1				

		PMT 300 KVA 400V				PMT 200 KVA 400V				PMT 100KVA 400V				PMT 50 KVA 400V			
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%			A	%			A	%	
1	20	0.80	336	78	21	0.80	224	78	14	0.80	112	78	7	0.80	48	67	3
1	30	0.80	336	78	14	0.80	216	75	9	0.80	96	67	4	0.80	48	67	2
1	40	0.80	320	74	10	0.80	224	78	7	0.80	96	67	3	0.80	32	44	1
1	50	0.80	320	74	8	0.80	200	69	5	0.80	80	56	2	0.80	40	56	1
1	70	0.80	336	78	6	0.80	224	78	4	0.80	112	78	2	0.80	56	78	1
1	100	0.80	320	74	4	0.80	160	55	2	0.80	80	56	1				
1	125	0.80	300	69	3	0.80	200	69	2	0.80	100	69	1				
1	150	0.80	240	55	2	0.80	120	42	1								
1	200	0.80	320	74	2	0.80	160	55	1								
1	250	0.80	200	46	1	0.80	200	69	1								
1	300	0.80	240	55	1												
1	400	0.80	320	74	1												

		PMT 300 KVA 380 V				PMT 200 KVA 380 V				PMT100 KVA 380 V				PMT 50 KVA 380 V			
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%			A	%			A	%	
1	20	0.80	352	77	22	0.80	240	79	15	0.80	112	74	7	0.80	48	63	3
1	30	0.80	360	79	15	0.80	240	79	10	0.80	120	79	5	0.80	48	63	2
1	40	0.80	352	77	11	0.80	224	74	7	0.80	96	63	3	0.80	32	42	1
1	50	0.80	360	79	9	0.80	240	79	6	0.80	120	79	3	0.80	40	53	1
1	70	0.80	336	74	6	0.80	224	74	4	0.80	112	74	2	0.80	56	74	1
1	100	0.80	320	70	4	0.80	240	79	3	0.80	80	53	1				
1	125	0.80	300	66	3	0.80	200	66	2	0.80	100	66	1				
1	150	0.80	360	79	3	0.80	240	79	2	0.80	120	79	1				
1	200	0.80	320	70	2	0.80	160	53	1								
1	250	0.80	200	44	1	0.80	200	66	1								
1	300	0.80	240	53	1	0.80	240	79	1								
1	400	0.80	320	70	1												

		PMT 300 KVA 220 V				PMT 200 KVA 220 V				PMT 100 KVA 220 V				PMT 50 KVA 220 V			
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%			A	%			A	%	
1	20	0.80	624	79	39	0.80	416	79	26	0.80	208	79	13	0.80	96	73	6
1	30	0.80	624	79	26	0.80	408	78	17	0.80	192	73	8	0.80	96	73	4
1	40	0.80	608	77	19	0.80	416	79	13	0.80	192	73	6	0.80	96	73	3
1	50	0.80	600	76	15	0.80	400	76	10	0.80	200	76	5	0.80	80	61	2
1	70	0.80	616	78	11	0.80	392	75	7	0.80	168	64	3	0.80	56	43	1
1	100	0.80	560	71	7	0.80	400	76	5	0.80	160	61	2	0.80	80	61	1
1	125	0.80	600	76	6	0.80	400	76	4	0.80	200	76	2				
1	150	0.80	600	76	5	0.80	360	69	3	0.80	120	46	1				
1	200	0.80	480	61	3	0.80	320	61	2	0.80	160	61	1				
1	250	0.80	600	76	3	0.80	400	76	2								
1	300	0.80	480	61	2	0.80	240	46	1								
1	400	0.80	320	41	1	0.80	320	61	1								

A8. TABLE FOR NO. OF METERS CAN BE SUPPLIED (FOR COMMERCIAL CENTER)

This Table shows No. of Meters can be supplied by PMTs and LV Conductors in Commercial Center for different Voltages (400 , 380 , 220 V) and for different CB Ratings (30 , 50 , 70 , 100 , 150 , 200 , 250 , 300 , 400) A.

		120 mm² Conductor capacity =200 A				50 mm² Conductor capacity =110 A			
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%	
0.7	30	1.00	147	74	7	1.00	84	76	4
0.7	50	1.00	140	70	4	1.00	70	64	2
0.7	70	1.00	147	74	3	1.00	49	45	1
0.7	100	1.00	140	70	2	1.00	70	64	1
0.7	150	1.00	105	53	1				
0.7	200	1.00	140	70	1				

		PMT 300 KVA 400V				PMT 200 KVA 400V				PMT 100KVA 400V				PMT 50 KVA 400V			
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%			A	%			A	%	
0.7	30	1.00	336	78	16	1.00	231	80	11	1.00	105	73	5	1.00	42	58	2
0.7	50	1.00	315	73	9	1.00	210	73	6	1.00	105	73	3	1.00	35	49	1
0.7	70	1.00	343	79	7	1.00	196	68	4	1.00	98	68	2	1.00	49	68	1
0.7	100	1.00	280	65	4	1.00	210	73	3	1.00	70	49	1				
0.7	150	1.00	315	73	3	1.00	210	73	2	1.00	105	73	1				
0.7	200	1.00	280	65	2	1.00	140	48	1								
0.7	250	1.00	175	40	1	1.00	175	61	1								
0.7	300	1.00	210	48	1												
0.7	400	1.00	280	65	1												

		PMT 300 KVA 380 V				PMT 200 KVA 380 V				PMT100 KVA 380 V				PMT 50 KVA 380 V			
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%			A	%			A	%	
0.7	30	1.00	357	78	17	1.00	231	76	11	1.00	105	69	5	1.00	42	55	2
0.7	50	1.00	350	77	10	1.00	210	69	6	1.00	105	69	3	1.00	35	46	1
0.7	70	1.00	343	75	7	1.00	196	64	4	1.00	98	64	2	1.00	49	64	1
0.7	100	1.00	350	77	5	1.00	210	69	3	1.00	70	46	1				
0.7	150	1.00	315	69	3	1.00	210	69	2	1.00	105	69	1				
0.7	200	1.00	280	61	2	1.00	140	46	1								
0.7	250	1.00	350	77	2	1.00	175	58	1								
0.7	300	1.00	210	46	1	1.00	210	69	1								
0.7	400	1.00	280	61	1												

		PMT 300 KVA 220 V				PMT 200 KVA 220 V				PMT 100 KVA 220 V				PMT 50 KVA 220 V			
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
	A		A	%			A	%			A	%			A	%	
0.7	30	1.00	630	80	30	1.00	420	80	20	1.00	210	80	10	1.00	105	80	5
0.7	50	1.00	630	80	18	1.00	420	80	12	1.00	210	80	6	1.00	105	80	3
0.7	70	1.00	588	75	12	1.00	392	75	8	1.00	196	75	4	1.00	98	75	2
0.7	100	1.00	630	80	9	1.00	420	80	6	1.00	210	80	3	1.00	70	53	1
0.7	150	1.00	630	80	6	1.00	420	80	4	1.00	210	80	2				
0.7	200	1.00	560	71	4	1.00	420	80	3	1.00	140	53	1				
0.7	250	1.00	525	67	3	1.00	350	67	2	1.00	175	67	1				
0.7	300	1.00	630	80	3	1.00	420	80	2								
0.7	400	1.00	560	71	2	1.00	280	53	1								

A9. TABLE FOR MAX LENGTHS WITHIN (5%) VOLTAGE DROP

This Table shows the Max Lengths (m) can be achieved within (5%) Voltage Drop for different Coincident Demand Load (KVA) and for different Nominal Voltages (400 , 380 , 220 V) and for different LV Conductors' Sizes (120 , 50 mm^2).

VD % =	5				PF =	0.85 Lag
Nominal Voltage	400 V	400 V	380 V	380 V	220 V	220 V
Conductor Size	120 mm2	50 mm2	120 mm2	50 mm2	120 mm2	50 mm2
K Constant	5064	2217	4570	2000	1532	671
CDL	Length	Length	Length	Length	Length	Length
(KVA)	(m)	(m)	(m)	(m)	(m)	(m)
5	480	480	450	450	260	260
10	480	480	450	450	260	260
15	480	480	450	450	260	224
20	480	480	450	450	260	168
25	480	443	450	400	260	134
30	480	369	450	333	255	112
35	480	317	450	286	219	96
40	480	277	450	250	191	
45	480	246	450	222	170	
50	480	222	450	200	153	
55	460	202	415	182	139	
60	422	185	381		128	
65	390		352			
70	362		326			
75	338		305			
80	316		286			
85	298		269			
90	281		254			
95	267		241			
100	253		229			
105	241		218			
110	230					
Firm Capacity (KVA)	111	61	105	58	61	34

A10. TABLE FOR MAX LENGTHS WITHIN (3.5%) VOLTAGE DROP

This Table shows the Max Lengths (m) can be achieved within (3.5%) Voltage Drop for different Coincident Demand Load (KVA) and for different Nominal Voltages (400 , 380 , 220 V) and for different LV Conductors' Sizes (120 , 50 mm^2).

VD % =	3.5				PF =	0.85 Lag
Nominal Voltage	400 V	400 V	380 V	380 V	220 V	220 V
Conductor Size	120 mm2	50 mm2	120 mm2	50 mm2	120 mm2	50 mm2
K Constant	5064	2217	4570	2000	1532	671
CDL	Length	Length	Length	Length	Length	Length
(KVA)	(m)	(m)	(m)	(m)	(m)	(m)
5	480	480	450	450	260	260
10	480	480	450	450	260	235
15	480	480	450	450	260	156
20	480	388	450	350	260	117
25	480	310	450	280	214	94
30	480	259	450	233	179	78
35	480	222	450	200	153	67
40	443	194	400	175	134	
45	394	172	355	156	119	
50	354	155	320	140	107	
55	322	141	291	127	97	
60	295	129	267		89	
65	273		246			
70	253		229			
75	236		213			
80	222		200			
85	209		188			
90	197		178			
95	187		168			
100	177		160			
105	169		152			
110	161					
Firm Capacity (KVA)	111	61	105	58	61	34

A11. TABLE FOR MAX LENGTHS WITHIN (1.5%) VOLTAGE DROP

This Table shows the Max Lengths (m) can be achieved within (1.5%) Voltage Drop for different Coincident Demand Load (KVA) and for different Nominal Voltages (400 , 380 , 220 V) and for different LV Conductors' Sizes (120 , 50 mm^2).

VD % =	1.5				PF =	0.85 Lag
Nominal Voltage	**400 V**	**400 V**	**380 V**	**380 V**	**220 V**	**220 V**
Conductor Size	**120 mm2**	**50 mm2**	**120 mm2**	**50 mm2**	**120 mm2**	**50 mm2**
K Constant	**5064**	**2217**	**4570**	**2000**	**1532**	**671**
CDL	**Length**	**Length**	**Length**	**Length**	**Length**	**Length**
(KVA)	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**
5	480	480	450	450	260	201
10	480	332	450	300	230	101
15	480	222	450	200	153	67
20	380	166	343	150	115	50
25	304	133	274	120	92	40
30	253	111	229	100	77	34
35	217	95	196	86	66	29
40	190	83	171	75	57	
45	169	74	152	67	51	
50	152	66	137	60	46	
55	138	60	125	55	42	
60	127	55	114		38	
65	117		105			
70	109		98			
75	101		91			
80	95		86			
85	89		81			
90	84		76			
95	80		72			
100	76		69			
105	72		65			
110	69					
Firm Capacity (KVA)	**111**	**61**	**105**	**58**	**61**	**34**

A12. TABLE FOR VOLTAGE DROP (%) IN (400 V) WITH (120 MM^2 CONDUCTOR)

This Table shows the Voltage Drop (%) in (400 V) LV Network with LV Conductor size (120 mm^2) for different Coincident Demand Load (KVA) with different Cables' Length (m).

Nominal Voltage	400 V			Conductor Size		120 mm2		K Constant		5064			PF =		0.85 Lag									
									Voltage Drop (%)																
Length (m) / CDL (KVA)	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500
5	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.30	0.32	0.34	0.36	0.38	0.39	0.41	0.43	0.45	0.47	0.49
10	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32	0.36	0.39	0.43	0.47	0.51	0.55	0.59	0.63	0.67	0.71	0.75	0.79	0.83	0.87	0.91	0.95	0.99
15	0.06	0.12	0.18	0.24	0.30	0.36	0.41	0.47	0.53	0.59	0.65	0.71	0.77	0.83	0.89	0.95	1.01	1.07	1.13	1.18	1.24	1.30	1.36	1.42	1.48
20	0.08	0.16	0.24	0.32	0.39	0.47	0.55	0.63	0.71	0.79	0.87	0.95	1.03	1.11	1.18	1.26	1.34	1.42	1.50	1.58	1.66	1.74	1.82	1.90	1.97
25	0.10	0.20	0.30	0.39	0.49	0.59	0.69	0.79	0.89	0.99	1.09	1.18	1.28	1.38	1.48	1.58	1.68	1.78	1.88	1.97	2.07	2.17	2.27	2.37	2.47
30	0.12	0.24	0.36	0.47	0.59	0.71	0.83	0.95	1.07	1.18	1.30	1.42	1.54	1.66	1.78	1.90	2.01	2.13	2.25	2.37	2.49	2.61	2.73	2.84	2.96
35	0.14	0.28	0.41	0.55	0.69	0.83	0.97	1.11	1.24	1.38	1.52	1.66	1.80	1.94	2.07	2.21	2.35	2.49	2.63	2.76	2.90	3.04	3.18	3.32	3.46
40	0.16	0.32	0.47	0.63	0.79	0.95	1.11	1.26	1.42	1.58	1.74	1.90	2.05	2.21	2.37	2.53	2.69	2.84	3.00	3.16	3.32	3.48	3.63	3.79	3.95
45	0.18	0.36	0.53	0.71	0.89	1.07	1.24	1.42	1.60	1.78	1.96	2.13	2.31	2.49	2.67	2.84	3.02	3.20	3.38	3.55	3.73	3.91	4.09	4.27	4.44
50	0.20	0.39	0.59	0.79	0.99	1.18	1.38	1.58	1.78	1.97	2.17	2.37	2.57	2.76	2.96	3.16	3.36	3.55	3.75	3.95	4.15	4.34	4.54	4.74	4.94
55	0.22	0.43	0.65	0.87	1.09	1.30	1.52	1.74	1.96	2.17	2.39	2.61	2.82	3.04	3.26	3.48	3.69	3.91	4.13	4.34	4.56	4.78	5.00	5.21	5.43
60	0.24	0.47	0.71	0.95	1.18	1.42	1.66	1.90	2.13	2.37	2.61	2.84	3.08	3.32	3.55	3.79	4.03	4.27	4.50	4.74	4.98	5.21	5.45	5.69	5.92
65	0.26	0.51	0.77	1.03	1.28	1.54	1.80	2.05	2.31	2.57	2.82	3.08	3.34	3.59	3.85	4.11	4.36	4.62	4.88	5.13	5.39	5.65	5.90	6.16	6.42
70	0.28	0.55	0.83	1.11	1.38	1.66	1.94	2.21	2.49	2.76	3.04	3.32	3.59	3.87	4.15	4.42	4.70	4.98	5.25	5.53	5.81	6.08	6.36	6.64	6.91
75	0.30	0.59	0.89	1.18	1.48	1.78	2.07	2.37	2.67	2.96	3.26	3.55	3.85	4.15	4.44	4.74	5.04	5.33	5.63	5.92	6.22	6.52	6.81	7.11	7.41
80	0.32	0.63	0.95	1.26	1.58	1.90	2.21	2.53	2.84	3.16	3.48	3.79	4.11	4.42	4.74	5.06	5.37	5.69	6.00	6.32	6.64	6.95	7.27	7.58	7.90
85	0.34	0.67	1.01	1.34	1.68	2.01	2.35	2.69	3.02	3.36	3.69	4.03	4.36	4.70	5.04	5.37	5.71	6.04	6.38	6.71	7.05	7.39	7.72	8.06	8.39
90	0.36	0.71	1.07	1.42	1.78	2.13	2.49	2.84	3.20	3.55	3.91	4.27	4.62	4.98	5.33	5.69	6.04	6.40	6.75	7.11	7.46	7.82	8.18	8.53	8.89
95	0.38	0.75	1.13	1.50	1.88	2.25	2.63	3.00	3.38	3.75	4.13	4.50	4.88	5.25	5.63	6.00	6.38	6.75	7.13	7.50	7.88	8.25	8.63	9.01	9.38
100	0.39	0.79	1.18	1.58	1.97	2.37	2.76	3.16	3.55	3.95	4.34	4.74	5.13	5.53	5.92	6.32	6.71	7.11	7.50	7.90	8.29	8.69	9.08	9.48	9.87
105	0.41	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98	5.39	5.81	6.22	6.64	7.05	7.46	7.88	8.29	8.71	9.12	9.54	9.95	10.37
110	0.43	0.87	1.30	1.74	2.17	2.61	3.04	3.48	3.91	4.34	4.78	5.21	5.65	6.08	6.52	6.95	7.39	7.82	8.25	8.69	9.12	9.56	9.99	10.43	10.86

A13. TABLE FOR VOLTAGE DROP (%) IN (400 V) WITH (50 MM^2 CONDUCTOR)

This Table shows the Voltage Drop (%) in (400 V) LV Network with LV Conductor size (50 mm^2) for different Coincident Demand Load (KVA) with different Cables' Length (m).

Nominal Voltage	400 V		Conductor Size		50 mm2		K Constant		2217		PF =		0.85 Lag												
									Voltage Drop (%)																
Length (m)	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500
CDL (KVA)																									
5	0.05	0.09	0.14	0.18	0.23	0.27	0.32	0.36	0.41	0.45	0.50	0.54	0.59	0.63	0.68	0.72	0.77	0.81	0.86	0.90	0.95	0.99	1.04	1.08	1.13
10	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72	0.81	0.90	0.99	1.08	1.17	1.26	1.35	1.44	1.53	1.62	1.71	1.80	1.89	1.99	2.08	2.17	2.26
15	0.14	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.49	1.62	1.76	1.89	2.03	2.17	2.30	2.44	2.57	2.71	2.84	2.98	3.11	3.25	3.38
20	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80	1.99	2.17	2.35	2.53	2.71	2.89	3.07	3.25	3.43	3.61	3.79	3.97	4.15	4.33	4.51
25	0.23	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.26	2.48	2.71	2.93	3.16	3.38	3.61	3.83	4.06	4.29	4.51	4.74	4.96	5.19	5.41	5.64
30	0.27	0.54	0.81	1.08	1.35	1.62	1.89	2.17	2.44	2.71	2.98	3.25	3.52	3.79	4.06	4.33	4.60	4.87	5.14	5.41	5.68	5.96	6.23	6.50	6.77
35	0.32	0.63	0.95	1.26	1.58	1.89	2.21	2.53	2.84	3.16	3.47	3.79	4.11	4.42	4.74	5.05	5.37	5.68	6.00	6.32	6.63	6.95	7.26	7.58	7.90
40	0.36	0.72	1.08	1.44	1.80	2.17	2.53	2.89	3.25	3.61	3.97	4.33	4.69	5.05	5.41	5.77	6.14	6.50	6.86	7.22	7.58	7.94	8.30	8.66	9.02
45	0.41	0.81	1.22	1.62	2.03	2.44	2.84	3.25	3.65	4.06	4.47	4.87	5.28	5.68	6.09	6.50	6.90	7.31	7.71	8.12	8.53	8.93	9.34	9.74	10.15
50	0.45	0.90	1.35	1.80	2.26	2.71	3.16	3.61	4.06	4.51	4.96	5.41	5.86	6.32	6.77	7.22	7.67	8.12	8.57	9.02	9.47	9.93	10.38	10.83	11.28
55	0.50	0.99	1.49	1.99	2.48	2.98	3.47	3.97	4.47	4.96	5.46	5.96	6.45	6.95	7.44	7.94	8.44	8.93	9.43	9.93	10.42	10.92	11.41	11.91	12.41
60	0.54	1.08	1.62	2.17	2.71	3.25	3.79	4.33	4.87	5.41	5.96	6.50	7.04	7.58	8.12	8.66	9.20	9.74	10.29	10.83	11.37	11.91	12.45	12.99	13.53

A14. TABLE FOR VOLTAGE DROP (%) IN (380 V) WITH (120 MM^2 CONDUCTOR)

This Table shows the Voltage Drop (%) in (380 V) LV Network with LV Conductor size (120 mm^2) for different Coincident Demand Load (KVA) with different Cables' Length (m).

Nominal Voltage 380 V | Conductor Size 120 mm2 | K Constant 4570 | PF = 0.85 Lag

Voltage Drop (%)

Length (m) / CDL (KVA)	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500
5	0.02	0.04	0.07	0.09	0.11	0.13	0.15	0.18	0.20	0.22	0.24	0.26	0.28	0.31	0.33	0.35	0.37	0.39	0.42	0.44	0.46	0.48	0.50	0.53	0.55
10	0.04	0.09	0.13	0.18	0.22	0.26	0.31	0.35	0.39	0.44	0.48	0.53	0.57	0.61	0.66	0.70	0.74	0.79	0.83	0.88	0.92	0.96	1.01	1.05	1.09
15	0.07	0.13	0.20	0.26	0.33	0.39	0.46	0.53	0.59	0.66	0.72	0.79	0.85	0.92	0.98	1.05	1.12	1.18	1.25	1.31	1.38	1.44	1.51	1.58	1.64
20	0.09	0.18	0.26	0.35	0.44	0.53	0.61	0.70	0.79	0.88	0.96	1.05	1.14	1.23	1.31	1.40	1.49	1.58	1.66	1.75	1.84	1.93	2.01	2.10	2.19
25	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88	0.98	1.09	1.20	1.31	1.42	1.53	1.64	1.75	1.86	1.97	2.08	2.19	2.30	2.41	2.52	2.63	2.74
30	0.13	0.26	0.39	0.53	0.66	0.79	0.92	1.05	1.18	1.31	1.44	1.58	1.71	1.84	1.97	2.10	2.23	2.36	2.49	2.63	2.76	2.89	3.02	3.15	3.28
35	0.15	0.31	0.46	0.61	0.77	0.92	1.07	1.23	1.38	1.53	1.68	1.84	1.99	2.14	2.30	2.45	2.60	2.76	2.91	3.06	3.22	3.37	3.52	3.68	3.83
40	0.18	0.35	0.53	0.70	0.88	1.05	1.23	1.40	1.58	1.75	1.93	2.10	2.28	2.45	2.63	2.80	2.98	3.15	3.33	3.50	3.68	3.85	4.03	4.20	4.38
45	0.20	0.39	0.59	0.79	0.98	1.18	1.38	1.58	1.77	1.97	2.17	2.36	2.56	2.76	2.95	3.15	3.35	3.54	3.74	3.94	4.14	4.33	4.53	4.73	4.92
50	0.22	0.44	0.66	0.88	1.09	1.31	1.53	1.75	1.97	2.19	2.41	2.63	2.84	3.06	3.28	3.50	3.72	3.94	4.16	4.38	4.60	4.81	5.03	5.25	5.47
55	0.24	0.48	0.72	0.96	1.20	1.44	1.68	1.93	2.17	2.41	2.65	2.89	3.13	3.37	3.61	3.85	4.09	4.33	4.57	4.81	5.05	5.30	5.54	5.78	6.02
60	0.26	0.53	0.79	1.05	1.31	1.58	1.84	2.10	2.36	2.63	2.89	3.15	3.41	3.68	3.94	4.20	4.46	4.73	4.99	5.25	5.51	5.78	6.04	6.30	6.56
65	0.28	0.57	0.85	1.14	1.42	1.71	1.99	2.28	2.56	2.84	3.13	3.41	3.70	3.98	4.27	4.55	4.84	5.12	5.40	5.69	5.97	6.26	6.54	6.83	7.11
70	0.31	0.61	0.92	1.23	1.53	1.84	2.14	2.45	2.76	3.06	3.37	3.68	3.98	4.29	4.60	4.90	5.21	5.51	5.82	6.13	6.43	6.74	7.05	7.35	7.66
75	0.33	0.66	0.98	1.31	1.64	1.97	2.30	2.63	2.95	3.28	3.61	3.94	4.27	4.60	4.92	5.25	5.58	5.91	6.24	6.56	6.89	7.22	7.55	7.88	8.21
80	0.35	0.70	1.05	1.40	1.75	2.10	2.45	2.80	3.15	3.50	3.85	4.20	4.55	4.90	5.25	5.60	5.95	6.30	6.65	7.00	7.35	7.70	8.05	8.40	8.75
85	0.37	0.74	1.12	1.49	1.86	2.23	2.60	2.98	3.35	3.72	4.09	4.46	4.84	5.21	5.58	5.95	6.32	6.70	7.07	7.44	7.81	8.18	8.56	8.93	9.30
90	0.39	0.79	1.18	1.58	1.97	2.36	2.76	3.15	3.54	3.94	4.33	4.73	5.12	5.51	5.91	6.30	6.70	7.09	7.48	7.88	8.27	8.66	9.06	9.45	9.85
95	0.42	0.83	1.25	1.66	2.08	2.49	2.91	3.33	3.74	4.16	4.57	4.99	5.40	5.82	6.24	6.65	7.07	7.48	7.90	8.31	8.73	9.15	9.56	9.98	10.39
100	0.44	0.88	1.31	1.75	2.19	2.63	3.06	3.50	3.94	4.38	4.81	5.25	5.69	6.13	6.56	7.00	7.44	7.88	8.31	8.75	9.19	9.63	10.07	10.50	10.94
105	0.46	0.92	1.38	1.84	2.30	2.76	3.22	3.68	4.14	4.60	5.05	5.51	5.97	6.43	6.89	7.35	7.81	8.27	8.73	9.19	9.65	10.11	10.57	11.03	11.49

A15. TABLE FOR VOLTAGE DROP (%) IN (380 V) WITH (50 MM² CONDUCTOR)

This Table shows the Voltage Drop (%) in (380 V) LV Network with LV Conductor size (50 mm²) for different Coincident Demand Load (KVA) with different Cables' Length (m).

Nominal Voltage 380 V | Conductor Size 50 mm2 | K Constant 2000 | PF = 0.85 Lag

Voltage Drop (%)

Length (m) / CDL (KVA)	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500
5	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.25
10	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00	2.10	2.20	2.30	2.40	2.50
15	0.15	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.65	1.80	1.95	2.10	2.25	2.40	2.55	2.70	2.85	3.00	3.15	3.30	3.45	3.60	3.75
20	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80	3.00	3.20	3.40	3.60	3.80	4.00	4.20	4.40	4.60	4.80	5.00
25	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00	6.25
30	0.30	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.30	3.60	3.90	4.20	4.50	4.80	5.10	5.40	5.70	6.00	6.30	6.60	6.90	7.20	7.50
35	0.35	0.70	1.05	1.40	1.75	2.10	2.45	2.80	3.15	3.50	3.85	4.20	4.55	4.90	5.25	5.60	5.95	6.30	6.65	7.00	7.35	7.70	8.05	8.40	8.75
40	0.40	0.80	1.20	1.60	2.00	2.40	2.80	3.20	3.60	4.00	4.40	4.80	5.20	5.60	6.00	6.40	6.80	7.20	7.60	8.00	8.40	8.80	9.20	9.60	10.00
45	0.45	0.90	1.35	1.80	2.25	2.70	3.15	3.60	4.05	4.50	4.95	5.40	5.85	6.30	6.75	7.20	7.65	8.10	8.55	9.00	9.45	9.90	10.35	10.80	11.25
50	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50	10.00	10.50	11.00	11.50	12.00	12.50
55	0.55	1.10	1.65	2.20	2.75	3.30	3.85	4.40	4.95	5.50	6.05	6.60	7.15	7.70	8.25	8.80	9.35	9.90	10.45	11.00	11.55	12.10	12.65	13.20	13.75

A16. TABLE FOR VOLTAGE DROP (%) IN (220 V) WITH (120 MM^2 CONDUCTOR)

This Table shows the Voltage Drop (%) in (220 V) LV Network with LV Conductor size (120 mm^2) for different Coincident Demand Load (KVA) with different Cables' Length (m).

Nominal Voltage 220 V
Conductor Size 120 mm2
K Constant 1532
PF = 0.85 Lag

Voltage Drop (%)

CDL (KVA) \ Length (m)	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500
5	0.07	0.13	0.20	0.26	0.33	0.39	0.46	0.52	0.59	0.65	0.72	0.78	0.85	0.91	0.98	1.04	1.11	1.18	1.24	1.31	1.37	1.44	1.50	1.57	1.63
10	0.13	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57	1.70	1.83	1.96	2.09	2.22	2.35	2.48	2.61	2.74	2.87	3.00	3.13	3.26
15	0.20	0.39	0.59	0.78	0.98	1.18	1.37	1.57	1.76	1.96	2.15	2.35	2.55	2.74	2.94	3.13	3.33	3.53	3.72	3.92	4.11	4.31	4.50	4.70	4.90
20	0.26	0.52	0.78	1.04	1.31	1.57	1.83	2.09	2.35	2.61	2.87	3.13	3.39	3.66	3.92	4.18	4.44	4.70	4.96	5.22	5.48	5.74	6.01	6.27	6.53
25	0.33	0.65	0.98	1.31	1.63	1.96	2.28	2.61	2.94	3.26	3.59	3.92	4.24	4.57	4.90	5.22	5.55	5.88	6.20	6.53	6.85	7.18	7.51	7.83	8.16
30	0.39	0.78	1.18	1.57	1.96	2.35	2.74	3.13	3.53	3.92	4.31	4.70	5.09	5.48	5.88	6.27	6.66	7.05	7.44	7.83	8.23	8.62	9.01	9.40	9.79
35	0.46	0.91	1.37	1.83	2.28	2.74	3.20	3.66	4.11	4.57	5.03	5.48	5.94	6.40	6.85	7.31	7.77	8.23	8.68	9.14	9.60	10.05	10.51	10.97	11.42
40	0.52	1.04	1.57	2.09	2.61	3.13	3.66	4.18	4.70	5.22	5.74	6.27	6.79	7.31	7.83	8.36	8.88	9.40	9.92	10.45	10.97	11.49	12.01	12.53	13.06
45	0.59	1.18	1.76	2.35	2.94	3.53	4.11	4.70	5.29	5.88	6.46	7.05	7.64	8.23	8.81	9.40	9.99	10.58	11.16	11.75	12.34	12.93	13.51	14.10	14.69
50	0.65	1.31	1.96	2.61	3.26	3.92	4.57	5.22	5.88	6.53	7.18	7.83	8.49	9.14	9.79	10.45	11.10	11.75	12.40	13.06	13.71	14.36	15.01	15.67	16.32
55	0.72	1.44	2.15	2.87	3.59	4.31	5.03	5.74	6.46	7.18	7.90	8.62	9.34	10.05	10.77	11.49	12.21	12.93	13.64	14.36	15.08	15.80	16.52	17.23	17.95
60	0.78	1.57	2.35	3.13	3.92	4.70	5.48	6.27	7.05	7.83	8.62	9.40	10.18	10.97	11.75	12.53	13.32	14.10	14.88	15.67	16.45	17.23	18.02	18.80	19.58

A17. TABLE FOR VOLTAGE DROP (%) IN (220 V) WITH (50 MM^2 CONDUCTOR)

This Table shows the Voltage Drop (%) in (220 V) LV Network with LV Conductor size (50 mm^2) for different Coincident Demand Load (KVA) with different Cables' Length (m).

Nominal Voltage 220 V | Conductor Size 50 mm2 | K Constant 671 | PF = 0.85 Lag

Voltage Drop (%)

Length (m) / CDL (KVA)	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500
5	0.15	0.30	0.45	0.60	0.75	0.89	1.04	1.19	1.34	1.49	1.64	1.79	1.94	2.09	2.24	2.39	2.54	2.68	2.83	2.98	3.13	3.28	3.43	3.58	3.73
10	0.30	0.60	0.89	1.19	1.49	1.79	2.09	2.39	2.68	2.98	3.28	3.58	3.88	4.18	4.47	4.77	5.07	5.37	5.67	5.97	6.26	6.56	6.86	7.16	7.46
15	0.45	0.89	1.34	1.79	2.24	2.68	3.13	3.58	4.03	4.47	4.92	5.37	5.82	6.26	6.71	7.16	7.61	8.05	8.50	8.95	9.40	9.84	10.29	10.74	11.19
20	0.60	1.19	1.79	2.39	2.98	3.58	4.18	4.77	5.37	5.97	6.56	7.16	7.76	8.35	8.95	9.54	10.14	10.74	11.33	11.93	12.53	13.12	13.72	14.32	14.91
25	0.75	1.49	2.24	2.98	3.73	4.47	5.22	5.97	6.71	7.46	8.20	8.95	9.69	10.44	11.19	11.93	12.68	13.42	14.17	14.91	15.66	16.41	17.15	17.90	18.64
30	0.89	1.79	2.68	3.58	4.47	5.37	6.26	7.16	8.05	8.95	9.84	10.74	11.63	12.53	13.42	14.32	15.21	16.11	17.00	17.90	18.79	19.69	20.58	21.48	22.37
35	1.04	2.09	3.13	4.18	5.22	6.26	7.31	8.35	9.40	10.44	11.48	12.53	13.57	14.62	15.66	16.70	17.75	18.79	19.84	20.88	21.92	22.97	24.01	25.06	26.10

A18. TABLE FOR DEMAND FACTOR VALUES

This Table shows the Demand Factor Values for different Customer Category Types according to SEC Distribution Planning Standards No.(DPS-01, Rev.02) titled (Estimation of Customer Load Guideline).

Code	Customer Category	Demand Factor (DF)
C1	Normal Residential Dwelling	0.60
C2	Normal Commercial Shops	0.70
C3	Furnished Flats	0.70
C4	Hotels	0.75
C5	Malls	0.70
C6	Restaurants	0.70
C7	Offices	0.70
C8	Schools	0.80
C9	Mosques	0.90
C10	Mezzanine in Hotel	0.75
C11	Common Area/Services in Buildings	0.80
C12	Public Services Facilities	0.75
C13	Indoor Parking	0.80
C14	Outdoor Parking	0.90
C15	Streets Lighting	0.90
C16	Parks & Garden	0.80
C17	Open Spaces	0.90
C18	Hospitals\Medical Facilities	0.80
C19	Medical Clinics	0.70
C20	Universities/High Educational Facilities	0.80
C21	Light Industries	0.90
C22	Workshops	0.60
C23	Cooling Stores	0.90
C24	Warehouses	0.70
C25	Community Halls	0.80
C26	Recreational Facilities	0.80
C27	Farms\Agricultural Facilities	0.90
C28	Fuel Stations	0.70
C29	Bulk Factories	0.90

A19. TABLE FOR COINCIDENT FACTOR VALUES

This Table shows the Coincident Factor Values for different Number of Meters according to SEC Distribution Planning Standards No.(DPS-01, Rev.02) titled (Estimation of Customer Load Guideline).

Number of Meters N	Coincident Factor CF(N)	Number of Meters N	Coincident Factor CF(N)	Number of Meters N	Coincident Factor CF(N)
1	1.000	34	0.581	67	0.568
2	0.723	35	0.581	68	0.568
3	0.688	36	0.580	69	0.568
4	0.668	37	0.579	70	0.568
5	0.654	38	0.579	71	0.567
6	0.644	39	0.578	72	0.567
7	0.636	40	0.578	73	0.567
8	0.629	41	0.577	74	0.567
9	0.624	42	0.577	75	0.566
10	0.619	43	0.576	76	0.566
11	0.616	44	0.576	77	0.566
12	0.612	45	0.575	78	0.566
13	0.609	46	0.575	79	0.566
14	0.607	47	0.575	80	0.566
15	0.604	48	0.574	81	0.565
16	0.602	49	0.574	82	0.565
17	0.600	50	0.573	83	0.565
18	0.598	51	0.573	84	0.565
19	0.597	52	0.573	85	0.565
20	0.595	53	0.572	86	0.564
21	0.594	54	0.572	87	0.564
22	0.592	55	0.572	88	0.564
23	0.591	56	0.571	89	0.564
24	0.590	57	0.571	90	0.564
25	0.589	58	0.571	91	0.564
26	0.588	59	0.570	92	0.564
27	0.587	60	0.570	93	0.563
28	0.586	61	0.570	94	0.563
29	0.585	62	0.570	95	0.563
30	0.584	63	0.569	96	0.563
31	0.583	64	0.569	97	0.563
32	0.583	65	0.569	98	0.563
33	0.582	66	0.568	99	0.563

A20. REFERENCES

This Guideline should be read in conjunction with all References mentioned in the Table below which includes all related SEC Distribution Material and Construction Specifications for Overhead LV Network.

SN	CODE	ITEM DESCRIPTION	REV.	DATE
1		SEC Customers Services Manual		
2	**01-SDMS-01**	General Requirements For All Equipment / Material	1	12/2003
3	**11-SDMS-01**	Low Voltage Power And Control Cables	2	03/2007
4	**11-SDMS-02**	LV Overhead Line Conductor Type Quadruplex	0	01/2002
5	**12-SDMS-02**	Lugs And Connectors For MV/LV Distribution System	2	03/2007
6	**31-SDMS-03**	Low Voltage Cabinet For Pole Mounted Transformer	1	02/2007
7	**34-SDMS-02**	M V & L V fuse links	0	10/2003
8	**37-SDMS-01**	Low Voltage Molded Case Circuit Breakers For Service Connections	3	10/2014
9	**37-SDMS-03**	Molded Case Circuit Breakers For Low Voltage PMT Cabinet 200 Amps	0	01/2006
10	**38-SDMS-03**	LV Digital Panel Meters	0	07/2009
11	**40-SDMS-01**	Bottom Connected Kilo-Watt-hour Meter	2	09/2010
12	**40-SDMS-02A**	Electronic Revenue CT And CT/VT Meters	7	03/2014
13	**40-SDMS-02B**	Electronic Revenue Whole- Current Meters	6	02/2012
14	**42-SDMS-01**	Fiber Glass Reinforced Polyester Meter Boxes	4	11/2007
15	**42-SDMS-03**	Inside Room Fiberglass Reinforced Polyester Meter Boxes	0	12/2007
16	**51-SDMS-01**	Distribution Transformers Up To 36KV	2	04/2004
17	**51-SDMS-02**	Distribution Transformers Up To 36kv 400/230 Volts	0	09/2010
18	**51-SDMS-03**	Distribution Transformers Up To 36KV 400/230 Volts with Aluminum windings	0	12/2013
19	**51-SDMS-04**	Distribution Transformers Up To 36kv 400/230 Volts with Aluminum windings for Dual secondary 400/230 v And 230/133 v	0	12/2013
20	**SDCS-01**	CONSTRUCTION STANDARD FOR OVERHEAD LINES	0	10/2004
21	**SDCS-02**	PART 2 - INSTALLATION OF KWH METERS INSIDE METER ROOMS AND INSETS	0	05/2005
22	**SDCS-02**	PART 3 - INSTALLATION OF RECESSED TYPE KWH METER BOXES INTO CONSUMER'S WALL	1	01/2009